RADIO-AUTOMOBILES-NEW INVENTIONS

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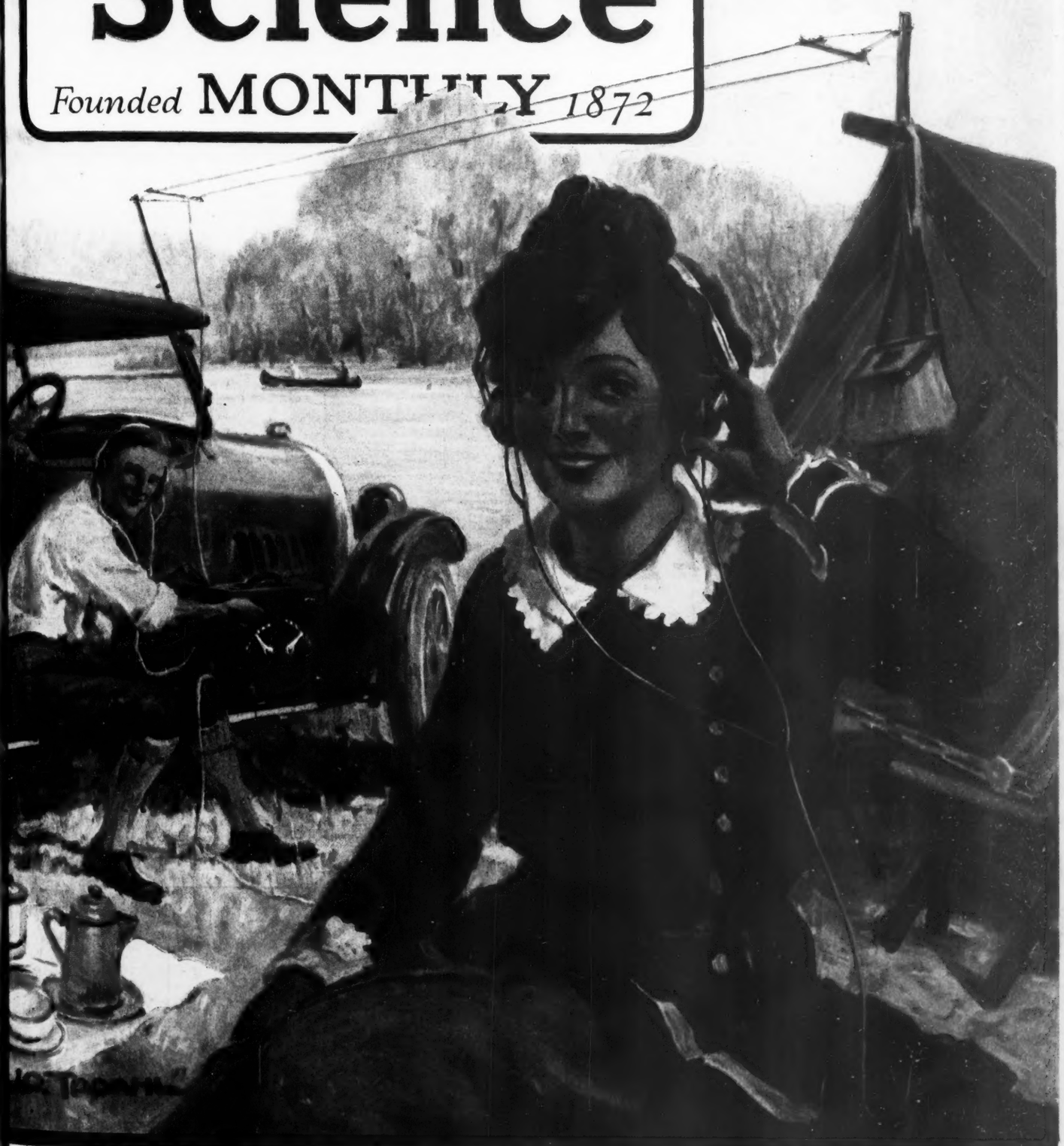

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My Three Years of Motor Camping

Experiences of a Pioneer in the Game, Who Reveals the Most Useful Equipment for a Successful Motor Vacation

By F. E. Brimmer, *Author of "Autocamping"*

THREE summers ago my wife and I made our first auto-camping trip. It seemed to us a radical and hazardous enterprise; but we soon discovered, as have hundreds of others in the past year or two, that this delightful method of vacationing can be made to combine the adventure and healthfulness of Western frontier days with the comfort of a 1922 apartment hotel.

We started, that first year, by packing half the contents of our kitchen into the tonneau. Since then experience has taught us what should be taken. This experience may guide the beginner in selecting everything that is essential, without burdening himself with articles that take valuable room in the car and prove unnecessary to enjoyment.

Home Comforts on the Road

Nowadays when you climb into your car and take to the open road for a summer of motor gipsying, you need not leave home behind. You may take its comforts with you. With the increasing popularity of motor camping as the great vacation sport of a nation, there has appeared on the market within the past few months a host of mechanical devices to make roadside living easy for the amateur. If you make or purchase your outfit with care, you can tour the country for four months or more without once stopping at a hotel, or realizing that you are "roughing it."

The Auto Tent—One of the most important of the new devices is the auto tent, which is made especially for comfortable shelter in motor camps. Some styles you attach to the car, while others are pitched independently. Some are so adaptable that you may or may not attach them, whichever you desire; but all types are superior to the old style tent that was designed for other purposes. A good auto tent may be made as cozy as (and far cooler than) a summer cottage.

In selecting the auto tent, I have found that the best way is to choose a model that will roll into a compact bundle, weigh as little as possible, and still be commodious and waterproof. It should be possible to put it up and take it down in five minutes at most—and this, if necessary, by one person. Get as much head room as possible. If an adult can stand erect anywhere in the tent, living will be far more comfortable. There should be one or two screened windows with curtains.

I have discovered that all the usual tent materials have their advantages. Balloon silk is costlier than canvas, but much lighter in weight and fully as efficient. Of course, both silk and canvas give better service when pitched in the shade, and a fly can be used to excellent advantage if a long stay is made in one place. Army duck, double filled, in 29-inch width and 10-ounce weight, which has been waterproofed, has proved to be very satisfactory under all conditions, even in snow country. Airplane cloth and silkette are other varieties of excellent tenting material offered the tourist.

I have found that the color of a tent should be carefully considered. White is conspicuous and hard on the eyes of the occu-

To unclamp the runningboard box from the car and convert it into a table with two shelves for cooking utensils, as shown above, takes only a minute

During five years of gipsying all over the United States, the flivver tourist shown at the left has accumulated a moving natural history museum

How to Start the Trip Right

AUTOMOBILE camping, within the past year or two, has become one of the most popular American vacation pastimes. In the accompanying article a pioneer among motor campers describes some of the essentials for a successful gipsy tour, which he learned in three years of actual experience.

Those of you who are planning a summertime auto camping trip will find these suggestions helpful. In addition, our Home Workshop Department tells you this month just how you can make your own equipment. Instructions for converting a car into a "house on wheels" appear on page 77. You can learn how to make a tent, page 80; a camping table, page 101; a folding camping stove, page 102; or even a trailer for your car, page 103.

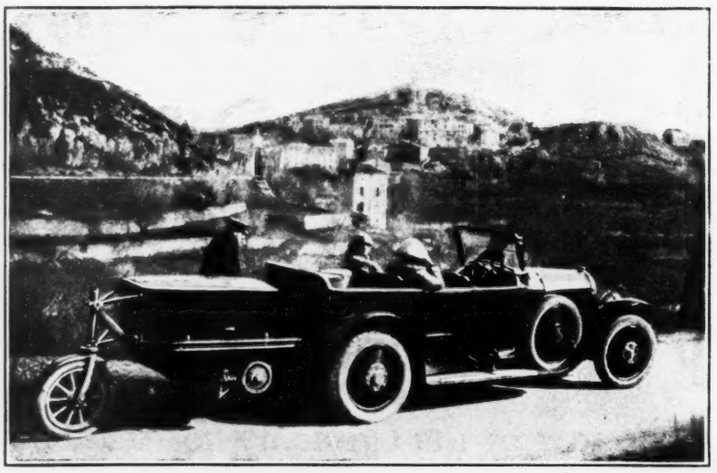
And if you are interested in how motor gipsies live on the road, read the prize-winning letters on page 70 and pictures of modern motor caravans on page 71.

inches long, and which, when

independence of the feudal

pants in sunlight, and at night every move of the persons in a lighted camp makes a shadow that reveals plainly what is going on inside. Either brown, khaki, or green canvas blends better with the landscape. The light transmitted is easier on the eyes and the walls are more opaque when the camp is illuminated at night.

The very latest tent for auto camping is a combination tent and bed. In this style of camp the bed forms the foundation for the tent, supporting its poles or frame. We have used several styles of tent-bed combinations and find that from the standpoint of comfort there is little difference between the combination and the tent itself. You can take your choice.



These gipsies pack all their luggage in an odd single-wheeled trailer consisting of a case supported by bars that are attached to the rear of the chassis

The Auto-Camp Bed—Comfortable beds mean comfortable camps, and our experience is that the double or single folding cot is excellent. We have used a double cot 52 inches wide, 78 inches long, and 18 inches high. When folded, this bed is 39 inches long, 10 inches wide, by 5 inches thick. We carry this in our car in place of the foot rail.

The single cot of "automatic" style is excellent. This automatically makes a level surface to sleep on, no matter how uneven the ground upon which the cot is placed.

The tonneau, or ear bed, which is generally suspended from the windshield to the rear of the car body, hanging over the seats, has its advantages. We have carried such a bed, weighing less than 8 pounds, and making a bundle about 4 inches in diameter, strapped to the top frame of our car. The tonneau bed is excellent for children, for an extra or emergency bed; but I cannot recommend it for permanent sleeping quarters. It has little head room and is none too easy to get into.

A Wide Choice of Beds

The pneumatic, or air bed—sometimes called a "comfort sleeping pocket," because the air mattresses are covered with a waterproof blanket that snaps in place to form a pocket in which one sleeps—is an ideal auto-camper's bed. When deflated and rolled, our double 42-inch air bed is about 12 inches in diameter, 42 inches long, and the weight is about 25 pounds, depending on the material of the waterproof covering and the weight of the wool lining in this air sleeping pocket. On our double air bed my wife and our younger daughter, who was but six months old on her first trip, have slept in the comfort of home. The air mattresses taper thinner at the foot and an "inner wall" construction has done away with the sliding sensation of the first pneumatic beds. A pump, larger of cylinder than a foot pump, but not nearly so effective and much lighter, comes with the air pocket. Personally I have always inflated our double bed with my lungs, which at most takes but five minutes.

When Nights Are Chilly

Some kind of bedding is needed with practically every style of bed. With our air bed we have used an eiderdown robe in cold weather. We also prefer a good woolen sleeping bag, or nest of two or three bags, to any ordinary wool blanket. Two 4½-pound woolen bags, nested together and covered with a waterproof canvas, make ideal bedding.

Auto-Camping Stoves—When the nights are chilly in high altitudes or during the cooler seasons, a collapsible, folding stove that burns wood has been indispensable to us. Baby has been undressed and dressed many times in the radius of its cheering warmth. The stove folds to 28 by 10 by 4½ inches, including its eight feet of pipe, two elbows, damper, four legs, bottom, lid-lift, and top lid. Carried in a canvas case this wood stove is smaller than a suitcase. For cooking, a very popular automobile camping stove is the two-burner gasoline firemaker. You have the fuel with you, heat is obtained quickly, there is no odor, and our experience is that the stove is safe to use anywhere in camp. You may have the gasoline stove with oven, frypan, spider, breadpan, etc., making a complete kitchenette. One of the very latest auto-camp stoves, and a model that we found most efficient last summer, is the compressed acetylene-gas burner. It should be mentioned that this same gas may be used for lighting your camp, and indeed you may cook and illuminate simultaneously. When empty, the tank may be exchanged for a filled one. The tank is a cylinder 6 by 20 inches. The light has a maximum intensity of 500 candlepower, which is plenty strong enough to sew or read by in comfort.

Just a few items of the author's 1922 camping equipment—a shotgun that folds like a jack-knife, an axe and two steel knives with sheaths, and a compressed acetylene-gas burner for cooking or lighting in the camp

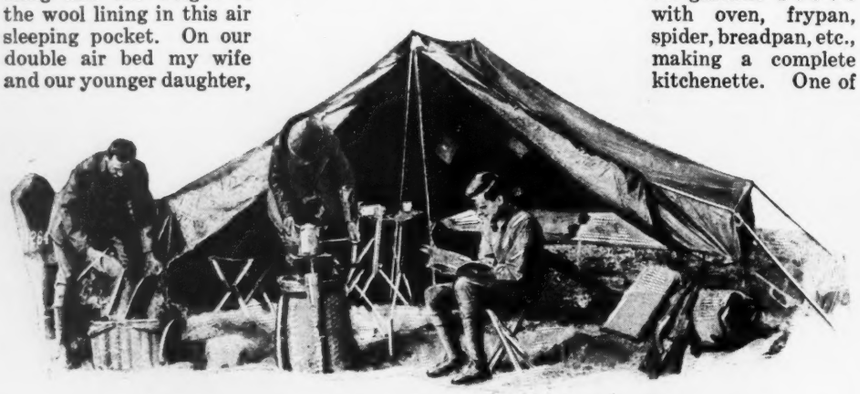
Refrigerator Basket—If you intend to set out motor gipsying with a baby, as we do, carry a refrigerator basket. With this basket icebox we carry our butter, fresh milk, fresh fruit, baby's modified milk, fresh meat, and indeed all perishable food. In camp we have the same food that we would eat at home! What is more, this basket is built to be dustproof and most sanitary. It is an excellent place in which to keep the drinking water, iced tea, or fruit beverages.

Kitchen Utensils that Pack Tightly

The refrigerator basket has a varnished exterior of woven reed, and a metal lining (the ice compartment is detachable), while between the two is an insulation that is a non-conductor of heat.

Cooking Utensils—By all means, do not take along your kitchen utensils. We found by sad experience that utensils collected from the kitchen cabinet never would become friendly on a camping trip, nor would they pack neatly together. We use a four-party aluminum set that comprises everything we could need—frypans, plates, coffee-pot, several pots with covers and bails, knives, forks, table- and teaspoons, salt and pepper shakers, cups and bowls. And the whole thing nests together, having detachable and folding handles, so that it packs in a canvas case 10 inches in diameter and about the same in height, while the weight is less than 10 pounds.

We have recently used a runningboard box that is about 9 inches square by 33



It's just like home when the author sets up camp. He is seen at the extreme left, taking butter from his refrigerator basket, while his wife cooks lunch over a small gas burner. Their tent is of light balloon silk

inches long, and which, when unclamped from the car, can be changed in 60 seconds into a table 27 by 33 inches, with two shelves. Within is a complete set of oval heavy tin dishes and utensils, including a gasoline stove, oven, and frypans.

Auto-Camp Furniture—As for furniture, we used to camp without a table, but this is not advisable. Folding chairs are compact and light in weight. A folding cupboard is homelike and handy. We should not know how to live without our folding washbasin. You may buy infants' dressing-tables and bathtubs if you like. They all fold to almost nothing. We find it highly advisable to carry a regular motor first-aid kit in a steel box, and the feeling of security that such a kit gives is worth much.

Other useful articles for camp are an axe with sheath, two good steel knives with sheaths, a matchbox of the waterproofed variety, and various personal toilet articles, hardware, mending outfits, and working tools. I always carry a folding firearm—either a rifle or shotgun—that folds like a jack-knife. Then we have game in season and are protected at all times.

Pick Your Camp Sites in Advance

"WHERE shall I find a good place to camp?" is the everlasting question that the gipsy motorist must answer at sundown, wherever the end of the day's journey brings him—in city, town, or country.

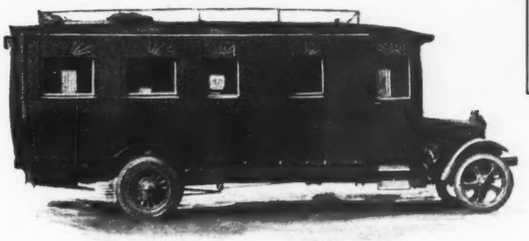
The motor camper is always on the lookout for a spot where he and his family may rest comfortably without disturbance and where simple necessities or conveniences for life out of doors are obtainable. Formerly he often wasted his time in vain search.

But now hundreds of convenient campsites are being set aside by cities and communities in all parts of the country, especially by those located along America's great transcontinental highways.

Just how can you find these sites during your trip?

It's easy this season; for an official camping and campsite manual has just been compiled by the American Automobile Association. This manual contains a list of more than 800 automobile campsites in all sections of the country, with exact location, description of equipment, and other detailed information for the motor camper, such as the number of autos the site will accommodate, water and wood supply, lighting facilities, playgrounds and amusements.

By special arrangement with the American Automobile Association, POPULAR SCIENCE MONTHLY is able to supply readers with copies of this invaluable manual. Send your request for a copy to the Automobile Camping Editor, Popular Science Monthly, 225 West 39th St., New York City, enclosing 50 cents and a self-addressed, stamped envelope.



Pullman car conveniences are included in the motorized home at the left. Above is the interior view of the car, showing how upholstered seats are made into a curtained berth

A Candle Is the Simplest

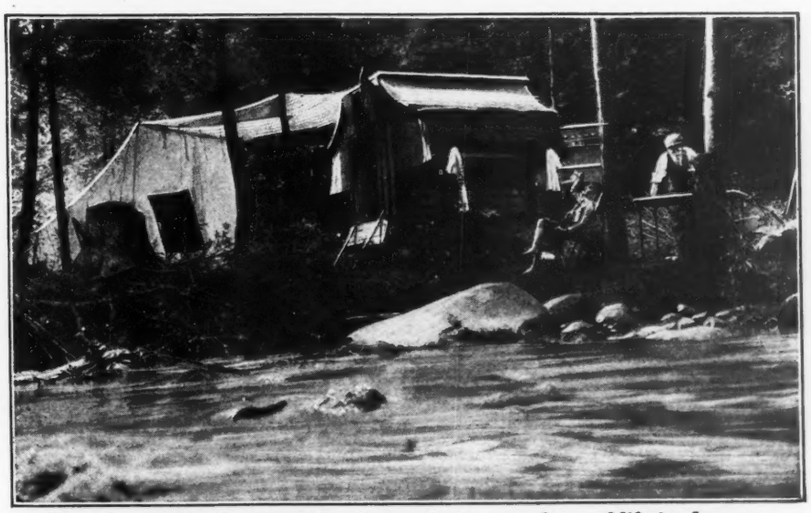
Camp Illumination—The simplest illumination is a candle, but be sure to take a plumber's candle. This is large in diameter, short of height, and burns a long time with a good light. We set the candle in a frypan, where there is no danger if it overturns. Or, better yet, carry it in a candle lantern. Many campers use a trouble light for camp, using electricity from the car battery. We can recommend the batteryless flashlamp for auto camping, for you are never fearful of exhausting a battery. We have found the ideal light is produced by the acetylene-gas lamp. This can be turned high for letter-writing or sewing, having a maximum of 500 candlepower.

Camping Trailer—The complete outfit for a protracted tour may seem bulky, but we have found that the trailer is excellent behind a heavy car and does not look too ungainly. It increases our gasbill about five per cent. The draw-pull of the average trailer—which weighs about 750 pounds—is between 20 and 25 pounds on the level road. Most trailers fold flat and if they are to be protected from the dust they must be covered by a very tight canvas.

Eat, Sleep, and Feel Better

With the hundreds of modern camping conveniences to choose from, we take our home with us. The world of automobile roads is our front yard! We have the independence of the feudal lord with all modern reservations. We live along the road and in municipal camping parks just the same as at home; we sleep better, eat better, and feel better.

It is our opinion that auto camping is becoming the most popular form of American vacation.



You can unfold your auto bungalow and win a new lease of life in the open, even if it's just for a day's outing

Horned Toad Can Live for Weeks without Food

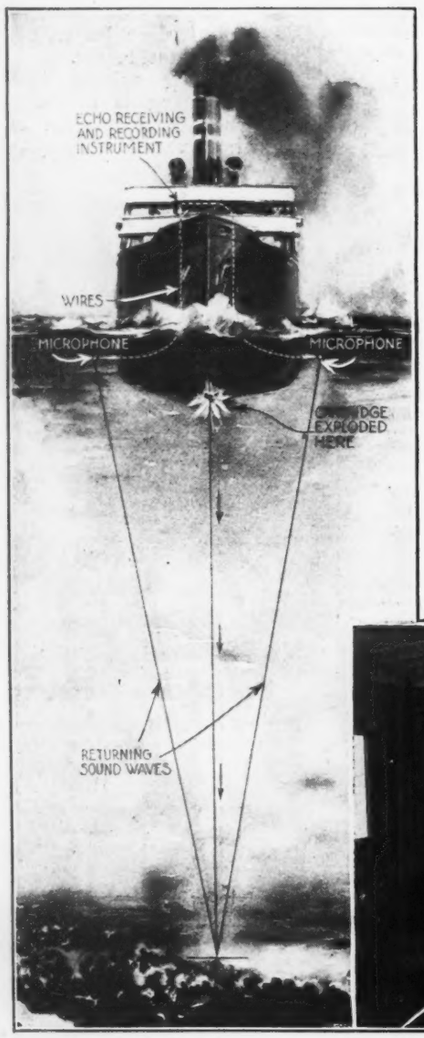
THE horned toad, rather than the camel, should be the prohibitionists' emblem. That this animal can live for 119 days not only without water, but in an absolutely dry atmosphere, has been demonstrated by Prof. F. G. Hall of the University of Wisconsin.

The scaly, impervious skin of the toad prevents evaporation from its body, it is found, while its organs are adapted to excrete insoluble crystals of uric acid instead of a fluid. Any water absorbed when the toad does take a drink, remains in the body, keeping the blood fluid almost indefinitely. How well the animal is protected is shown by the fact that after four months in an atmosphere made absolutely dry by enclosing a pan of concentrated sulphuric acid in the container, the toad lost only 35 per cent of its weight. Under the same conditions an angleworm lost 65 per cent in four hours, and warm-blooded animals would have lost weight nearly as fast.

Unlike the toad experimented upon by Professor Hall, the camel does not really do without a drink, but simply converts stored up fat into moisture. An Arab picks out a camel with a fat, well developed hump for travel in the desert. The camel will not drink on the journey; but at the end of the trip the hump is thin and shrunken. As the camel's tissues start to dry, the oxygen dissolved in the blood attacks the fat, and changes it into water. Since part of this "metabolic water" comes from the air, a pound of fat makes several pounds of fluid.

Echo Soundings Save Ships from Reefs

Depth of Water Is Now Measured by Timing Sound Vibrations Reflected from Ocean Bottom

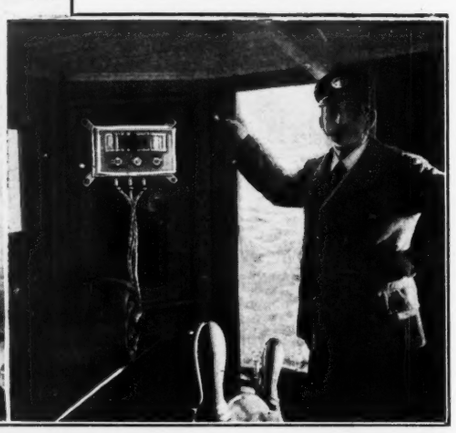


BY giving a sea captain constant knowledge of the depth of water under his ship's keel, even while the vessel is steaming at high speed toward land, an echo sounding device recently perfected by the United States Navy is expected to prevent liners from running aground in fogs.

The device is based upon the fact that sound waves in water behave as they do in air. A vibration in the water is reflected from the ocean bottom exactly as a sound wave is reflected from a brick wall. By measuring the time required for a sound to travel from a sender at the keel of the ship to the ocean bottom and back again to microphones on both sides of the vessel, the captain can determine the depth to within a few feet of absolute accuracy.

Since sound travels nearly 5000 feet a second in water, the time-measuring apparatus must be exceedingly accurate, and in fact time intervals of 1/1000 of a second can be recorded. The sound is produced by firing a cartridge under water. This cartridge is exploded by depressing an electric key on the navigating bridge. The same current starts the time recorder, which is stopped by a relay actuated by the reflected sound wave from the bottom.

By measuring the time elapsing between the explosion of a cartridge at the ship's keel and the return of the echo from the ocean bottom to microphones at the sides of the vessel, the captain, knowing the approximate velocity of sound in water, can determine the depth. The time-recording instrument is shown below



Continuous Soundings Possible

If the bottom is rocky or uneven, the least depth will be registered; and this, of course, is what the navigator wants to know. The new invention also makes possible a series of soundings only a few hundred feet apart. By the old method employing the hand lead or the sounding machine in which a heavy lead and many fathoms of wire must be reeled in after every cast, readings every quarter mile are about the limit.

By means of the intermittent sounds given by the new instrument, the knowledge that the water is becoming shallow will warn the navigator to change his course, or even to stop and anchor, long before the ship is in actual danger of touching bottom.

The device also will make it possible to measure spots in the oceans of the world which heretofore have remained unmeasured because of their great depths. One such spot is in the Gulf of Mexico, north of Yucatan.

Electricity Measures Velocities in Trash-Filled Drainage Pipes

A FEW handfuls of salt and a voltmeter are enabling government engineers working near Dayton, Ohio, to measure the velocity of water in drainage pipes while transporting heavy loads of earth.

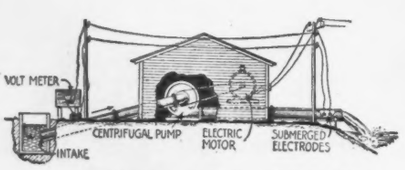
Though there have been methods by which velocity of clean water can be determined, no way of obtaining the speed of water carrying a heavy load of silt had ever been found until an engineer discovered an application for the fact that water becomes an excellent electrical conductor when salt is dissolved in it.

In applying the test, a sheet of zinc and a sheet of copper were hung in the pipe, insulated from it and from each other. These were connected with a sensitive voltmeter, which would normally read about 0.2 volts.

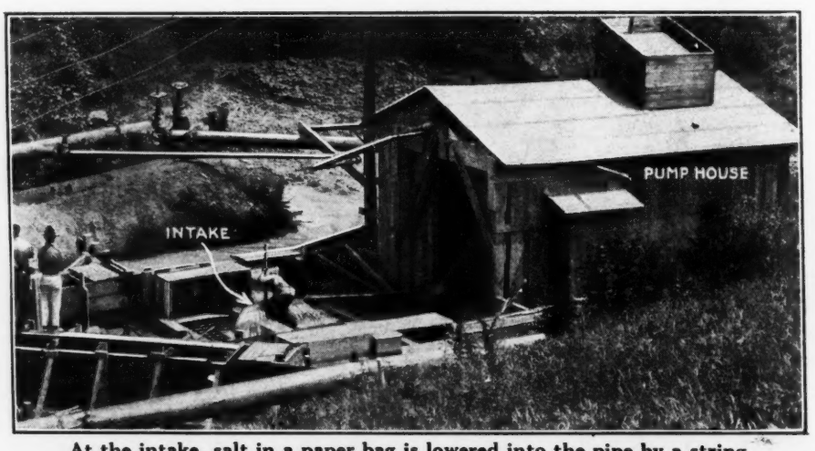
A pound of salt in a paper bag was then attached to a string and lowered near the suction intake. The instant the sack entered the pipe, the cord was jerked from the engineer's hand. This marked the time the salt started its journey. The paper bag was soon broken as it passed through the pump, and when the half dissolved salt struck the plates connected with the voltmeter, there was an unmistakable jump of potential to 0.5 volts.

Thus it was possible to determine the time required for the salt to pass through the pipe by simply noting the time the salt was inserted at the pump and the time it arrived at the end of the pipe and caused a jump in the voltmeter needle.

With the length of the pipe and the time taken for the salt to traverse it determined, the velocity of the stream was obtained. This method can be used in handling fresh water or non-conductive liquids.

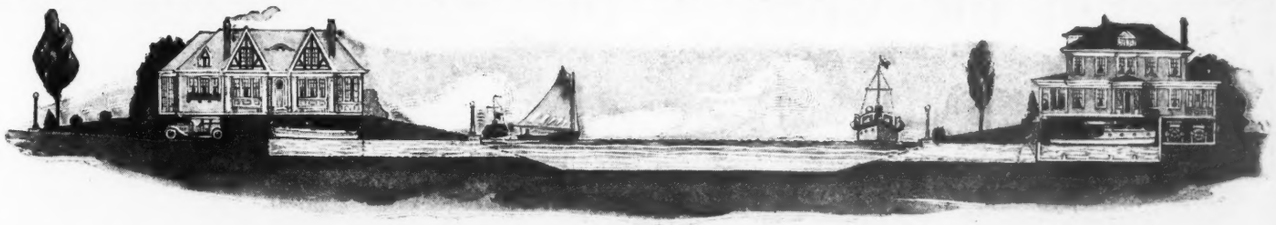


When salt, passing through the pipe, reaches submerged electrodes at the outlet, its arrival is recorded by a jump in the voltmeter needle



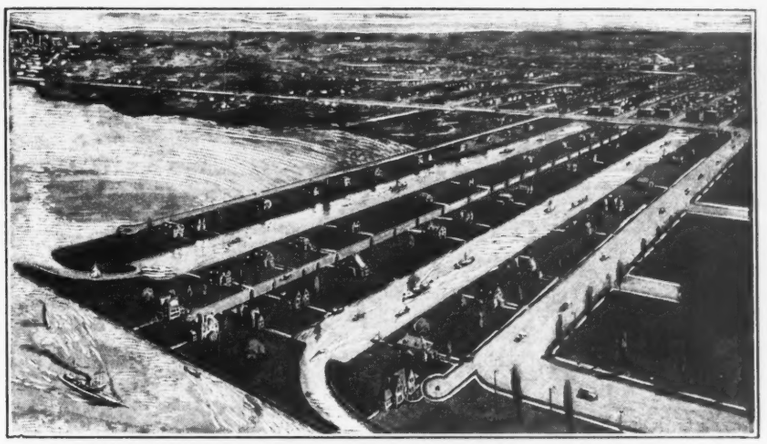
At the intake, salt in a paper bag is lowered into the pipe by a string. Release of the string marks time of entry

Boat and Auto Meet in "American Venice" Homes



MOTOR boats and automobiles will meet in the basements of their owners' residences at Grayhaven—a modern Venice recently laid out as a restricted residence district of Detroit, Mich. Even the picturesque city on the Adriatic cannot boast such land-and-water advantages the year round as this suburb combines.

Every home will be fronted on one side by a lagoon, and on the other by a paved boulevard. When the family wants to go for a spin on the highways or for a ride on the river, they will simply descend to the basement of their home and hop into their automobile or power boat.



This bird's-eye view of the "American Venice" shows how the Detroit River current, caught by a jetty, flows through a curved inlet and into one lagoon, then around the land end of the artificial island to the second lagoon, and back into the river

Arrangement of garages and boatwells in the basements of Grayhaven residences, each of which is fronted on one side by a lagoon and on the other by a boulevard, is illustrated above

Grayhaven consists of an artificial island in the Detroit River, flanked on both sides by lagoons and tongues of land jutting out into the river. The island between the two strips of land is connected with the shore by a bridge that leads into an automobile road dividing the island into symmetrical halves. A jetty at the entrance of the upstream lagoon forces the current in the Detroit River to flow through a curved inlet into this lagoon, then to the land end of the strip, under the connecting bridge, to the other lagoon and back to the river through a curved outlet.

A House Accessible by Land or Water

Every home will be accessible from the automobile road by a driveway leading to the garage in the basement of the house, and from the lagoon by a forebay leading to a boatwell underneath the house. The channel of the lagoons is lined with concrete and bordered by a sea wall. As there is a constant current through the lagoons, the water cannot become stagnant.

Residents can enjoy boating, canoeing, hydroplaning, or swimming during the summer. In winter, when the lagoons are covered with a smooth sheet of ice, they may skate or enjoy the sport of iceboating.

The garages will be large enough to hold two cars, while the boatwells will accommodate a large launch or several smaller craft. The boatwells are provided with watertight gates and may be changed to drydocks by pumping out the water. By automobile the residents can reach the business section of Detroit in a few minutes, while launches carry them quickly to the river.

Movie Camera Will Time Races Accurately

THANKS to a few feet of moving-picture film, mechanically exact timing will be possible at future big track meets.

The runners and the clock will be in view of the camera from start to finish. Timing to the hundredth of a second is assured, and the winner of a so-called "dead heat" can be selected with certainty, even if he breaks the tape at the finish line less than an eighth of an inch ahead of his closest contestant.

The moving-picture camera is focused simultaneously on a timing clock showing seconds and tenths of seconds, and on a near-by mirror reflecting the start of the race.

The clock and camera are set going before the starter fires his pistol. The flash of the pistol, reflected in the mirror, is recorded on the film, and the finish is photographed directly, since the camera is placed squarely on the finish line.

Timing each contestant is thus simply a matter of observing from the film the position of the time hand when the pistol flash is seen, and subtracting this reading from the reading when the runner crosses the line in front of the camera.

Focused on clock and mirror, the camera records unmistakably the time of start and finish

Can We Live Forever in an Icebox?

WHETHER organisms might not be kept alive forever—a question raised by the famous experiments of Dr. Jacques Loeb with the "immortal" chicken tissues at the Rockefeller Institute—is now answered in the negative by this eminent biologist, as a result of another series of remarkable experiments on "aseptic" flies.

Writing one of the 12 interesting chapters in the volume, "Contemporary Science," the ninety-ninth of the Modern Library Series (Boni & Liveright), Dr. Loeb remarks that lowering the temperature of an organism lengthens its life, but that "higher organisms must die from internal causes, even if all chances of infection and all accidents are excluded."

Testing the theory that death is due to a series of chemical reactions, and that these reactions are affected by temperature, he arrives at these results:

Aseptic flies, reared at a temperature of 30° C., had an average life of 21.15 days; at 20°, 54.3 days, and at 10°, 177.5 days.

By lowering their temperature 20 degrees, the duration of life was prolonged 900 per cent!

"Unfortunately," concludes the writer, "our body does not tolerate any considerable lowering of its temperature."

On the Crest of the Radio Wave

Jack Binns broadcasts the latest news of radio to the readers of *Popular Science Monthly*

By Jack Binns

America's First Wireless Hero and Most Famous Writer on Radio

When Your Set Won't Work
How to Hear the Longer Waves
The "Whys" of a Crystal Detector
Will Radio Swing the Next Election?

"IS radio just a passing craze?"

"Will the manufacturers abandon their broadcasting programs as soon as the market has become so flooded with their apparatus that future sales are impossible?"

These are the two questions I have been asked most frequently since the radio-telephone swept over the country like a cyclone, carrying popular enthusiasm in its wake. When we take into consideration the following facts: first, that it takes $4000 a month to operate a typical broadcasting station; and, second, that the artists are not being paid for the radio entertainment they give, it will readily be seen that the answers are vital to us all.

In fact, the problem appears so grave to all who, like myself, believe radio *must* have a marvelous future, that I am taking my first opportunity of talking with POPULAR SCIENCE MONTHLY readers to point out what I think the solution may be.

A Utility, Not a Craze

First, however, I want to impress upon you a realization of the fact that radio is neither a craze nor a toy. It is a very serious and important public utility which will gain in magnitude and value every day. But don't let your enthusiasm for it lift you out of the realm of facts. NOW is the time for everybody to come back to earth, to become familiar with the actual conditions of radio, and to plan sanely for the future.

At present, profits from the sale of radio receiving apparatus cover the cost of broadcasting. But that cost, in the case of one corporation, reaches $288,000 a year. Free broadcasting services obviously cannot go on forever, at that scale, and surely some payment to the artists will have to be made ultimately.

Now, in my opinion, there is only one solution to this problem. It lies in the probable attachment of a slot machine to every radio receiver—a machine so designed that a family will drop a nickel in the box for an evening's entertainment. The receipts collected monthly would assuredly be enough to enable the operating companies to provide even more elaborate and costly entertainments than at present, and to pay the artists adequately.

Will We Have Nickel-in-the-Slot Radio Receiving Sets?

"But how could this be done?" you ask. "What is to stop anybody with a radio set from listening in?"

Two ways are already recognized by experts as possible, but a combination of both of them would be best. In the first place, it is possible to so distort the voice transmitted by wireless telephony that it becomes absolutely unintelligible to every receiver that is not equipped with a translating modulator pitched to the right degree of resonance. Then, in the second place, it is possible to rapidly change the wave length carrying the voice so that some phrases will be carried on one wave length and succeeding phrases on another. Thus only an automatically controlled receiver could follow the rapid changes. A combination of these two systems would make it impossible for any one to be a "deadhead" at the radio-phone concerts.

I am quite sure that the public will welcome this innovation, when it comes. It will leave our receiving sets free to hear the ever increasing quantity of news and information that many agencies will be eager to broadcast gratis, and it will put at our disposal, in addition, for a remarkably low price, musical entertainments far surpassing any program yet attempted.

The Essential High Spots of Radio

JACK BINNS, America's most famous writer on radio, starts with this issue to cover the essential high spots of radio news for POPULAR SCIENCE MONTHLY readers. His radio department will be an exclusive feature of POPULAR SCIENCE MONTHLY in the magazine field.

The mass of radio publications and articles becomes more bewildering every day. You cannot read them all, you cannot digest them all, you cannot pick and choose among them to find just the information you most vitally need to keep abreast of the times and to make the most of your outfit.

You will find POPULAR SCIENCE MONTHLY, then, the one necessary magazine. It is a central clearing house for all the radio information that is most important to you. Jack Binns, keeping by profession in closest touch with radio developments, reports the new activities of chief public concern. Both he and Armstrong Perry contribute timely advice and illuminating explanations in terms that the non-technical man can understand. The Home Workshop Department supplies diagrams and descriptions important to the man who is making or improving his own radio set during spare hours at home.

On page 4 of this issue you will find an outline of the other special radio services offered by the magazine, including blueprints of radio sets to make at home, and POPULAR SCIENCE MONTHLY'S standard broadcasting chart.

"As Easy as A B C!"

I HAPPENED to be in a radio store the other day, and I overheard a young woman turn to a girl companion, and exclaim:

"Really, Blanche, it's foolish to buy one of these radio phones. We'll never be able to use it. Just listen to those awful names we've got to learn!"

At the same moment, an ardent young amateur was asking a bewildered new salesman whether he thought a variocoupler and tickler were better for a regenerative set than a variocoupler and two variometers, and wouldn't three honeycomb coils be the best of all? He was also inquiring how many microfarads capacity the secondary oscillating circuit condenser should have.

I listened with a great deal of interest, because I realized that just such situations as this might be, even now, profoundly discouraging thousands of potential radio fans. And my mind reverted to an incident of the previous week, when, with Louis Pacent and "Ed" Glavin, inventor of the radio-controlled automobile, I had acted as a judge in a radio competition in Newark, N. J. One of the prizes in this competition was for the best homemade receiving set, using homemade parts exclusively. The competitors were all boys under 14 years of age.

The boy who was adjudged the winner had

made a perfectly good working set out of a wooden soapbox. He had wound his coils around two breakfast-food cardboard boxes. His condenser consisted of a number of metal plates, spaced apart with washers. The detector was contained in a thimble, and the contact for it consisted of an ordinary safety-pin. This crude set, made up of odds and ends from the pantry and dressing-table, received music perfectly.

Don't Let Terms Scare You

I do not think anything better illustrates the simplicity of radio. Don't be frightened by the technical terms that are applied to various apparatus. You'll soon learn that the things they describe are simple bits of wire, or plates of metal. Scientists have applied the technical terms simply for their own convenience.

Radio is an infinitely bewildering mystery—but you don't need to solve it to enjoy it. In fact within the next six months the radio receiving apparatus will be so simple that only one adjustment will be necessary, and any child can work it.

Electioneering by Radio

THERE isn't the slightest doubt in my mind that the next national election will be decided in the ether. Politicians will be addressing larger audiences than they ever dreamed of. Woe betide the candidate who overlooks radio! The party with the best wireless campaign will swing the election.

In this connection, it is a very interesting fact that radio lends itself well to great oratory, provided the orator prepares himself for the peculiar conditions that prevail in the radio studio.

This point was made the other day in a chat I had with E. H. Armstrong, now world famous as the inventor of the regenerative circuit, which makes popular radio possible. It was just after Armstrong's important victory in the Federal courts. He told me about his new superregenerative circuit that he has completed, which will revolutionize radiophone reception by making it possible to get loudspeaking results without any outside wires anywhere. He added:

"I was listening in on this set at my home in Yonkers, the other Sunday, and heard a sermon that was being preached in Pittsburg. The parson was a natural orator, and his words thundered out one moment, and the next they came in a mere whisper. The emotion-stirring modulations of his voice came to me as perfectly as if I had been right beneath the pulpit, instead of three hundred miles away."

Howard Armstrong did not mention, however, the peculiar conditions with which the new style of public speaker—the radio orator—must comply. In the first place, when a silver-tongued speaker, gifted with the natural power of swaying an audience, speaks into the microphone at a broadcasting station, he will have to learn a new form of address. Every time he raises his voice, he will have to take a couple of steps backward from the microphone, and when his voice dies down to a whisper, he will have to creep forward closer to the mouthpiece. If he does not do this, he will paralyze half a million receivers when his voice mounts into a crescendo of sound, and the entire effect of his impassioned tones will have been destroyed because, once a vacuum tube has been paralyzed, it takes fully 30 seconds for the tube to recover. In fact, this whole question of speaking to the radio audience needs a great deal of study.

The Future Radio Star

Just as the movies have developed a new style of acting, radio will develop a new style of oratory. And I venture to predict that the great radio star of the future will be worth almost as big a salary as the movie queen of today. The man who can sway millions nightly, by the spoken word alone, without any of the personal magnetism and dramatic tricks that the skilled platform speaker uses, will indeed be a genius, much in demand at high prices.

I shall never forget the first time I spoke over the ether. No words can adequately describe that forlorn sensation. There is utter lack of that personal touch that puts a speaker and audience in sympathy. I tried to be funny Just tell a really laughable joke, as I did that night, and have it fall on a vast, blank solemn void, and you'll know how I felt.

They say campaign oratory has been standardized for years, and that it all sounds alike. But you may as well prepare yourselves, now, for a type of political speech in the next presidential campaign such as has never before been delivered.

Jack Binns at his desk, explaining the operation of a well known type of radio instrument—the variometer

An Epochal Message

JACK BINNS, now the most popular expert on radio in America, is the man who flashed the first wireless rescue call ever sent from a sinking ship. His historic message, "CQD—Come—Quick—Danger," speeding from the shattered wireless cabin of the sinking liner *Republic* spelled life for 1650 passengers.

It was 5:30 a. m. on the morning of January 23, 1909, when the steamship *Florida* suddenly loomed out of a North Atlantic fog and crashed deep into the engine-room of the *Republic*. Three sides of the wireless shack were torn away by the collision. The lever of Binns' sending key was broken, but passengers heard the crackle of the receiving wireless almost on the heels of the crash. Holding the key together with one hand, Binns pounded out a radio call that woke the Atlantic. The *Florida* disappeared in the fog. Binns realized he held in his hands the safety of every soul aboard. And then his set went dead. The inrushing water had reached the ship's dynamos.

Running aft, Binns discovered that the storeroom, where the storage batteries were kept, was already flooded with water, but in the darkness he dove into the wreckage and swam about until he found the batteries. These he connected with his set, and for the next 36 hours he stuck at his key, never faltering until, by intensive, clever radio work, he guided nine vessels to where the *Republic* lay sinking, lost in the fog. Every passenger was saved.

During the war, Binns was an instructor of wireless and aviation in the Canadian Air Forces and later in England.

Your "Troubles" and Mine!

OF course it's exasperating to have your set give you trouble right in the midst of some snappy musical selection that is being played or sung in the distant broadcasting station. But when this happens, don't get sore and blame the apparatus, or say radio has been overboomed. In ninety cases out of a hundred, the fault does not lie with the set itself. In all probability, you have overlooked some minor adjustment.

Perhaps only those of us who suffered in the early days of wireless development realize what manufacturing miracles have been wrought in turning out the precise, finely tuned, simply adjusted radio sets you can buy to-day. When I first started in wireless work, the only detector that existed was the *coherer*—and a lot of *incoherent* messages it brought me! It was a little glass tube, in which there were a number of iron filings between two silver plugs. This detector was placed directly in the secondary circuit, and when the electromagnetic waves were received on the aerial, they caused these filings to cohere and offer a path for a current from a local battery to pass through the local circuit and operate the recording device.

This little coherer was so sensitive that the vibration of the ship would operate it, and although I succeeded in working with one for a whole year, I never did really know whether I was getting wireless signals from some other ship, or just listening to our own ship's complaints about the weather!

At that, these meaningless messages tapped off on the tape by the vessel's vibrations were interesting, because they broke up the monotony of the pioneer wireless operator's life. There were probably only a dozen or so radio-equipped ships—and the chances for any conversations among them were rare. The ether was, to all intents, one great silence. And that was only 18 years ago!

Later came the magnetic and crystal types of detectors, and with them a multitude of instruments, every one of which was variable and had to be adjusted and readjusted. The operation and appearance of a station became infinitely more puzzling to the layman than all the rest of the ship's mechanism combined. At that time, for instance, an inductance coil was a very imposing thing, perhaps five feet high and six inches in diameter. Now, a coil doing exactly the same work is not more than two inches in diameter, and one inch high!

This is a sample of the simplicity in design that has been achieved throughout the sets you now are using. So, when you are turning your tuner knob and tickler knob, and think you have a lot of complex tinkering to do, give a thought to the days when one had to make more than a dozen skilled adjustments.

Business Is Fine!

YOU have never before been able to witness so spectacular an industrial event as is occurring under your eyes today. Had you ever thought of radio, six months ago, as having any particular interest to you personally? Probably not—and yet this spring radio has become a dominant business factor throughout the country.

Do you realize that America is now spending about $5,000,000 a week for radio equipment? Do you know that the unfilled orders of one radio manufacturing company alone amount to $50,000,000? Another conservative manufacturer expects to be turning out $25,000's worth of receiving sets daily by the time this issue of POPULAR SCIENCE MONTHLY reaches its readers!

It is safe to estimate that in these times of depression, when people were supposed not to have money to spend, the American public has already invested $100,000,000 in little boxes and tubes and coils of wire whose sole function is to bring entertainment or information into the home. And this is only the start. An annual radio business of $400,000,000 is confidently expected.

The bare figures of the radio boom are as romantic as is the form of recreation which it brings. One manufacturer of a new loudspeaker made 18,000 sales within six weeks of the start of manufacture. Another concern will have to turn out 200,000 receiving outfits before catching up with orders already on the books. With an output of 100,000 vacuum tubes a month, something like "normal" production has been attained by a leading group of manufacturers. To attain it they have been working night and day shifts at top speed.

With the probable establishment of from 12 to 15 powerful broad-casting stations that will cover the entire country—not to mention a host of other public and independent stations—and with the certainty that improvements in apparatus will keep up sales for years to come, it is undeniable that radio has within a period of six months leaped up as a vast national utility on a par in promise with the automobile, the motion pictures, and with public services like the telephone and electric railways.

And this has all happened since POPULAR SCIENCE MONTHLY launched its wireless campaign last November with the avowed purpose of "radio-izing" America. There has never been so spectacular a proof of the importance of science in current affairs, and of the necessity for every man to keep up with its amazing progress.

To Get the Big Waves

THE prompt action of the Federal authorities in inquiring into the conditions of the ether caused by the radiotelephone broadcasting system, has done a great deal to place the new form of entertainment on a permanent basis and to eliminate the interference that would have quickly killed it before it had a chance to develop. Now we shall have a perfect policing of the air.

One of the important results of the conference, however, is the desire it has created in the army of radio novices to listen to the stations operating on the longer wave lengths. This is emphasized principally because the government broadcasting stations are using the longer wave lengths.

Ever since the findings of the committee were published, I have been repeatedly asked the following general question: "How can I listen to WYCB [the station on Bedloe's Island, New York] or NAA [the station at Arlington, Va.] with my short-wave tuner?"

In a general way, there is only one way to do it, and that is by the use of loading coils. Loading coils are simply coils of wire, similar in every way to ordinary tuning coils. They add a certain amount of wire in condensed form to the aerial wire, thus increasing the total amount of inductance in the tuning circuit.

The problem that embarrasses the novice, however, is just where to place this loading coil. It is embarrassing, too, to the experienced radio man, because the question cannot be answered in a general way.

In the first place, if you are using a simple crystal detector with a single coil, it is a simple matter to put a honeycomb coil in the aerial circuit in series with the usual tuning coil. In this case the honeycomb coil will have to have sufficient inductance to make up for the difference between the normal wave-length range of the receiving set and the wave length of the station you wish to listen to.

In the case of the more elaborate sets using vacuum tubes, it is not so easy to decide just where the loading coils should go, but it is a pretty safe bet that you will get the desired results if you load up the aerial, as in the simple sets just described, but with the addition, also, of a similar coil in the plate circuit. In the latter case it will be necessary to experiment until just the right position between the primary loading coil and the plate loading coil has been obtained, because a regenerative action takes place between them.

See article in the Home Workshop Department, on how to make a honeycomb coil.

Nature's Electric Valve

WHAT is a crystal detector? Of what does it consist and how does it work? Since the advent of radio-telephone concerts, the answer to this question is bound up in the story of galena and its properties. Galena is an ore of lead, consisting of lead sulphide. It is in the crystalline form that this ore is best known to the wireless amateur and novice, although it has been known to man since the time of Pliny, the Roman naturalist.

Now galena, when placed in an electric circuit, has the remarkable and valuable property of rectification, or, in other words, it will permit a current to flow through it in only one direction. It completely checks the opposing current.

Rapid Alternations

This is a property that is urgently needed in wireless circuits, which deal exclusively with very high-frequency alternating currents. In fact, the frequency of the average radio currents received from the broadcasting stations throughout the country is at the rate of 833,333 cycles a second; which means that the current changes direction, or, in more exact terms, changes from positive to negative—at the rate of 1,666,666 times a second.

These current changes are so rapid that they exert an equal pull in either direction on the telephone diaphragm, and consequently the telephone would not respond to them. Now, if we can eliminate one half of them, say the positive half, and allow only the negative half to flow through the telephone, we shall hear the radio signals.

Galena does just that. It performs its duty in exactly the same manner that a valve works in a waterpipe system. It permits the current to flow forward through the circuit, and stops any back flow. In other words, it transforms alternating current—which flows rapidly in both directions—into pulsating current flowing in only one direction, and thus enables the telephone to record what is passing through the air.

For the purposes of wireless telegraphy, galena is a very sensitive detector, but for radio-phone work it is not reliable at a greater distance than 25 miles. I have often been asked if there is any other crystal just as good. The answer is, no. The element silicon is almost as good, and the combination of zincite-bornite is not bad, but neither element equals galena.

mitted at present

Uncle Sam "Gets Set" for Broadcasting

Of 220 Radio Stations Owned by Our Government, Nine Are Now Transmitting News and Programs of Public Interest

By Armstrong Perry

IF the next edition of the dictionary contains the expression "free as air," the words will be followed by the abbreviation *obs.*, which means "obsolete, or no longer having its original meaning."

Persons who think that the air is still free have a rude awakening when they try to use it for sending messages to distant friends. In some countries plain citizens are not permitted to transmit messages by radio at all. In our country we can do so only if we have a license from the Department of Commerce. To obtain that license we must study radio until we can answer all the technical questions that a government examiner wishes to ask. Also, we must study the dot-and-dash code until we can prove in tests that we can receive and decode messages at the rate of 10 words a minute.

The fact that we may have no desire to send or receive messages in Morse code makes no difference. Experience shows that Mrs. Jones, owning a transmitting set, might, if she did not know the code, fill the air along a stretch of seacoast so full of descriptions of millinery that Bill Jones, whose ship was sinking with a thousand passengers just over the black horizon, might not be able to bring to the attention of the nearest vessels and shore stations three letters, "SOS."

Use of the Air Restricted

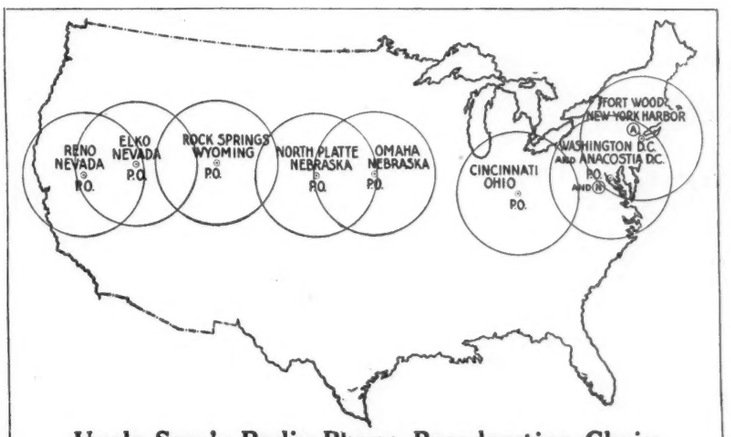
But after passing the license examination, Mrs. Jones would know the meaning of the buzzing dots and dashes that say: "Stop sending," or, to be still more blunt: "Shut up—we need the air for disaster messages."

So, the air is no longer free.

The man who wants to make a dollar has, of course, been the first to grasp the situation. Since the use of the air must be restricted and parceled out among the people, he has tried to make sure that he got his first. At the radio conference called by Secretary of Commerce Hoover at the request of President Harding, all who wanted to reserve portions of the ether were invited to present their cases. Some of the applications were interesting. For example, a mercantile concern wanted licenses for several hundred transmitting stations within what, from the standpoint of radio, is a comparatively small area. Even if this concern had built its stations, and the government had kept everybody else quiet within the territory, it is doubtful if even the best radio receiver could have made anything intelligible out of a jumble of songs, dances and advertisements broadcasted from all these stations.

Another concern, gigantic in its present operations in wire service, has already started to establish great radio broadcasting stations for the use of the public. Such great utilities under private control seem to be essential to the nation. The very fact that private corporations have built up country-wide broadcasting services almost overnight, while the government is still fumbling with the idea, indicates again the value of private enterprise in developing a new utility in the experimental stage.

Most private corporations have gone after the rights to the air wisely, aiming to give good service. There are more persons today kicking because other stations prevent their hearing the corporation broadcasts than there are kicking because these broadcasts are in the air. The corporations are entitled to the credit that belongs to the pioneer, the concern that strives to win popularity by doing something that is of real value to the people. But when all is said and done, the fact remains that the future value and interest of radio to us all depends upon the government's taking over its own share of the national broadcasting work. What we want is radio service for the people from the government of the people.


RENO NEVADA PO.
ELKO NEVADA PO.
ROCK SPRINGS WYOMING PO.
NORTH PLATTE NEBRASKA PO.
OMAHA NEBRASKA PO.
CINCINNATI OHIO PO.
FORT WOOD NEW YORK HARBOR A
WASHINGTON D.C. AND ANACOSTIA D.C. PO. AND N

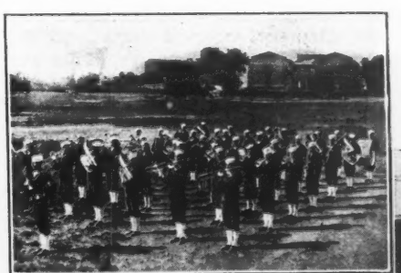
Uncle Sam's Radio-Phone Broadcasting Chain

Locations of the government stations that are now transmitting telephone broadcasts are indicated on the above map. "A" signifies Army station; "N," Navy; "PO," Post Office Department. The small circles represent receiving range of crystal detector sets, the large of higher priced audion receiving sets. This chart shows that the Post Office radiotelephone stations alone serve as the possible skeleton of a vast government broadcasting system that could be planned to cover the whole nation

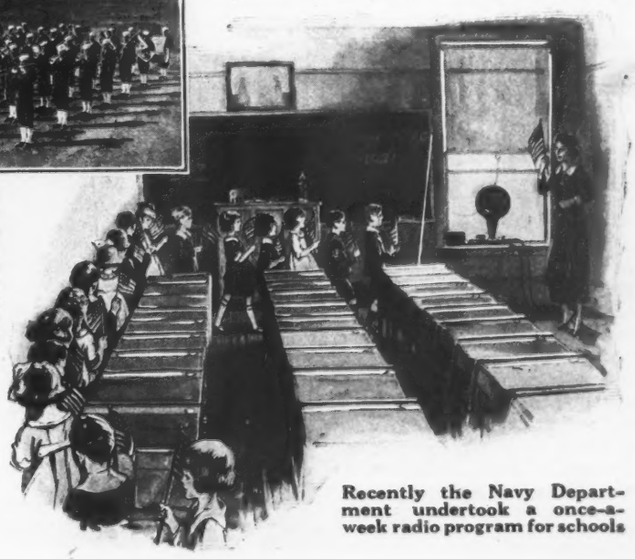
Idle Hours Could Be Used

Government ownership of radio facilities is a present fact, not a theory. The list of radio stations of the United States shows 220 stations already owned by our government on land or on moored ships. There is no home so isolated that it cannot hear a government radio station if it has a receiver adapted to the purpose.

Many government radio stations are idle for a large part of the 24 hours. The departments controlling them are not averse to using them for the public good. Of course, all traffic handled is for the public benefit, but much of that trans-



In the district school government radio could start the day's program with a lively march from a military band and a short talk on current events from the Bureau of Education



Recently the Navy Department undertook a once-a-week radio program for schools

IN this article Armstrong Perry tells of the existing skeleton around which an effective government broadcasting service can be built. In a future issue he will describe astounding future possibilities of a national broadcasting system.—THE EDITOR.

mitted at present would not interest the individual listener. He would not care, for example, whether the Shipping Board vessel, *Jeff Davis*, called at Norfolk for orders, or proceeded direct to New Orleans, though indirectly that might be of sufficient importance to the public to justify a message from the Shipping Board's headquarters in Washington to the vessel at sea. After such traffic is disposed of, why should the government station remain idle while every owner of a radio set is tuning up and down through the ether seeking a wider variety of entertainment and information?

Our interest in our senator and representative does not cease when we cast our ballot. We have much at stake in the problems they are tackling from day to day. Must we hear from them only through the newspapers? Why not listen to them talk, as the radio makes it possible to do?

We have government bands that make as good music as any that we pay foreign artists to produce. Many Americans would rather hear the Washington Marine Band, the band at the Presidio, or battleship bands in which inland mothers' sons are playing, than orchestras from Germany, Russia, and Italy. We have radio stations that can send the music to us. We pay for these stations. Why not use them?

The Post Office Department has given a splendid demonstration of what public radio stations can do. Carrying information to the public has been the Post Office's business ever since there was one. In using the airplane and radio it is merely keeping abreast of the times. Across the continent at intervals of a few hundred miles the Department has a complete chain of stations. Some time ago the Department of Agriculture was invited to send out through these radio stations information that the farmers need. Up to that time Solomon Buyupski, purchaser of the products of farm and ranch, had the advantage of being in closer touch with the market than Josh Slocum who plowed the soil, planted the seed and took chances on the results.

The price that was offered for produce and that the farmer accepted often was far below what the farmer could have asked and received if he had known the state of the market at the moment as well as did the buyer.

The Bureau of Markets, which is part of the Department of Agriculture, began delivering to the Post Office radio stations up-to-the-minute quotations several times a day and these are shot out immediately to the farmers, and any one else who cares to listen. The records show that the gain to individual farmers from single quotations has sometimes amounted to hundreds of dollars. But the farmer needs more than that. He can have, if he will ask for it, not only government radio service that helps his pocketbook, but also service that feeds his brain, and makes farm life less isolated and lonely.

The Navy was the first Department to inaugurate a broadcast service. Not claiming any jurisdiction over landlubbers, the naval officers began by addressing their news broadcasts to "all naval vessels," but a lot of shore folks who never smelled salt spray at once picked them up. In Washington the Naval Air Station broadened its service and demonstrated the possibilities of radio as an aid to education. Twice a week it opened for one hour in the evening. It started with a concert and a 10-minute lecture by the Public Health Service. Then there was more music, and after that another brief lecture covering concisely some phase of radio or airplane development.

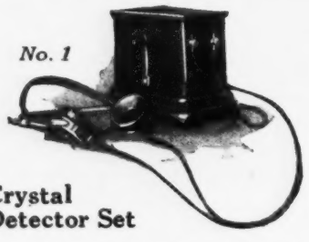
One afternoon a week a program for public schools was broadcasted. This service demonstrated the tremendous educational possibilities that lie in the expansion of government broadcasting programs. What a help it would be to the teacher of a district school to be able to start the day with a peppy march from a military band, followed by a 15-minute talk from the Bureau of Education in which the current events that were of importance to the pupils and their homes were covered in such a way that the arithmetic, geography, spelling and reading lessons would be but the continuation of a history in which the pupils were conscious of playing a worthy part!

Facts to Help You Choose Your Radio Set

HOW much must I pay for a radio receiving set? What will its range be? What will it look like when I install it? Of what will it consist?

These questions have been asked so frequently by our readers that we publish herewith photographs of receiving sets of various prices, with conservative estimates of their "normal' range.

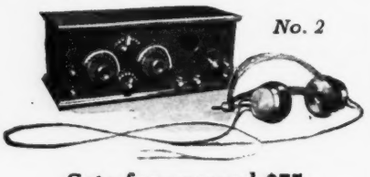
No. 1



Crystal Detector Set

1—As a beginner's outfit and for amateurs living near some broadcasting station the crystal detector set, costing around $25, is simple to adjust. This set consists of a tuning coil, a fixed condenser and phones. The receiving range of these crystal detector sets, even with a good aerial, is usually limited to 25 miles.

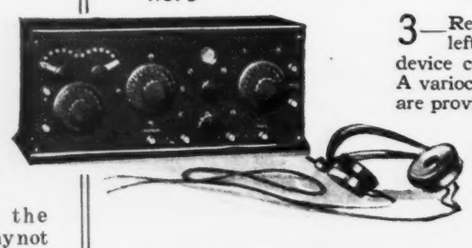
No. 2



Sets for around $75

2—These outfits, popular with beginners, will tune more closely to the wave lengths you wish to hear than will the "crystal" sets. The cabinet contains the variocoupler, single variable condenser and vacuum tube with filament current control. Outside range, 50 to 100 miles. A loudspeaker cannot be used satisfactorily with this or set No. 3 unless very near a broadcasting station.

No. 3



A 200-Mile Range for $125

3—Receiving sets in the class of that shown at left cost about $125 and comprise a tuning device connected with a vacuum tube detector. A variocoupler and two variable air condensers are provided. If connected with an outside aerial of proper design, it should pick up radio-phone messages from stations 200 miles distant.

Outfits over $225 Use Loudspeakers

4—For $225 and up, the finest sets are obtainable, using a loudspeaking device as shown at the right. With a set of this type, containing an excellent tuning unit and two stages of audio frequency amplification, broadcasting stations 500 miles away and, under good conditions, two or even three times that distance, should be heard.

No. 4

Keeping You Up-to-Date in Radio

WITH exclusive articles each month by two of America's foremost authorities on radio—Armstrong Perry and Jack Binns—supplemented by a wide range of other helpful radio information, including broadcasting charts, a blueprint service, and answers to questions on wireless problems, Popular Science Monthly is aiming to give readers the best all-round information and helpful radio service available.

In addition, Popular Science Monthly's new booklet, "The Standard Radio Guide," is an invaluable supplement to the regular monthly radio articles. This booklet is now on sale for 50 cents.

Our famous broadcasting chart of the United States, corrected up to date, and showing all the great wireless broadcasting stations you may want to hear, giving location, call letters, range and all other important details necessary to the owner of a receiving set, will be supplied by Popular Science Monthly's Blueprint Department at a charge of 25 cents. In ordering this chart, send stamps, cash or money order to Blueprint Department, Popular Science Monthly, 225 West 39th St., New York City.

Instruments that Lead Forward March of Radio

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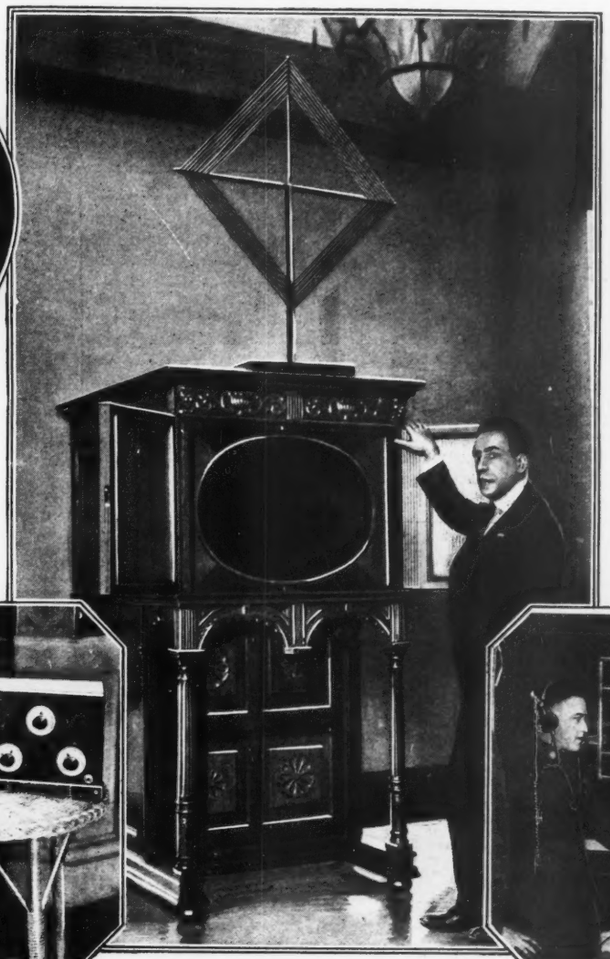
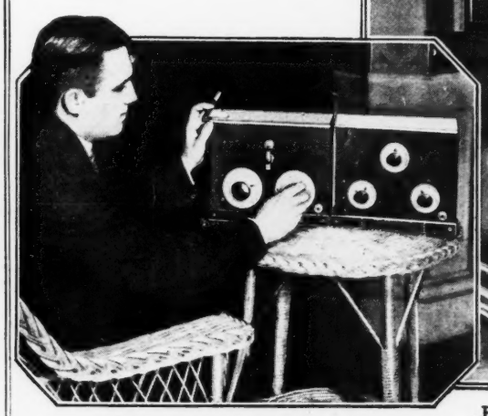
An umbrella is used as a "ground" for this "radio ring" receiving set, which is only one inch long and five eighths inch wide



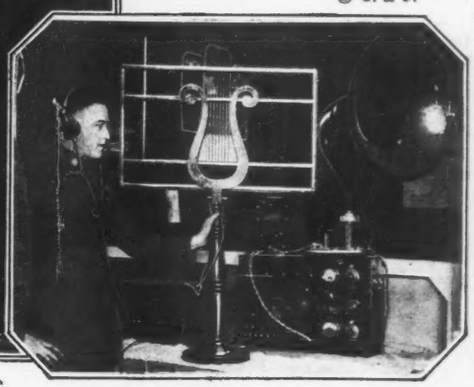
If an outdoor aerial is not available, a few turns of wire around a wooden frame indoors will make this "radio grand" deliver sounds as loud as a talking machine

© U. & U.



Similar units for both tuning and vacuum tube cabinets are included in this compact receiver. If the tubes go wrong, concerts can still be heard with the crystal detector shown in the center of the left hand cabinet. The set comprises a detector and two stages of amplification

For ballrooms and auditoriums, where large volumes of sound are required, this cabinet combining radio and phonograph is proving effective. The rear of the box contains, on one side, a talking machine mechanism, and on the other a sensitive radio set. The aerial is the loop arranged over the cabinet



This lyre-shaped antenna is designed for use in conjunction with the "radio grand" shown at the top of the page. The aerial is attractive in the home, while performing as effectively as an outside antenna. It is shown above connected with a sensitive receiver of the United States Signal Corps

In the Army radio station, over which the Goddess of Liberty holds her torch in New York harbor, officers in charge have admirably combined a program of radio training for amateurs who will be needed in case of war, with a program of entertainment capable of reaching and interesting at least 20 per cent of the population of the United States.

The Amateur Radio Reserve, a civilian organization fathered by the Department of the East, endeavors to make the Army radio entertainments widely useful. It is a fine piece of army and civilian cooperation. The government station puts the music, stories, lectures, and addresses into the air. The Reserve pulls them down for the home folks in a score or more of states. The show is heard as far south as Fort McPherson, Georgia, and as far west as Fort D. A. Russell in Wyoming.

The distribution of government land radio stations is wider than most citizens know. Here is where they are:

Alabama, 2; Arizona, 1; California, 9; Delaware, 1; District of Columbia,7; Florida, 8; Georgia, 3; Illinois, 4; Indiana, 1; Kansas, 2; Louisiana, 3; Maine, 2; Maryland, 8; Massachusetts, 4; Michigan, 6; Minnesota, 2; Missouri, 1; Nebraska, 3; Nevada, 2; New Hampshire, 2; New Jersey, 5; New York, 8; North Carolina, 3; Ohio, 3; Oklahoma, 1; Oregon, 3; Pennsylvania, 2; Rhode Island, 2; South Carolina, 3; Texas, 10; Utah, 1; Virginia, 6; Washington, 7; Wisconsin, 1; Wyoming, 2; Alaska, 27; Canal Zone, 5; China, 4; Cuba, 2; Guam, 1; Haiti, 1; Hawaii, 3; Navassa Island, West Indies, 1; Nicaragua, 1; Philippine Islands, 11; Porto Rico, 2; Samoa, 1; San Domingo, D. R., 1; Siberia, 1; Virgin Islands, 2.

Not all of the government radio stations are equipped with radiotelephone transmitters, but they could be. And the service the radio-phone stations are now giving is only rudimentary. It is interesting as far as it goes. The foregoing description of what the government is now doing for the public in radio is written primarily because it suggests the vast future possibilities of government broadcasting, provided people demand this development and realize that the skeleton of the system is already within their control.

Following are the government radio stations that transmit telephone broadcasts and their programs. It must be remembered that because of the rapid transitions in the development of broadcasting, this schedule may be changed at any moment. To keep up to the minute on government broadcasting, write to POPULAR SCIENCE MONTHLY'S Information Department.

NAVY

Naval Air Station, Anacostia, D. C. Call letters NOF. 360 and 1100 meters. Special programs of general interest.

ARMY

Signal Corps Station, Fort Wood, New York harbor. Call letters WVP. 1450 meters. Concerts 9 P. M. daily, gives some of the finest radio concerts that are put into the air anywhere.

POST OFFICE DEPARTMENT

Washington, D. C. Call letters WWX. 1800 meters. 10 A. M., weather report. 10:30 A. M., market reports. 7:30 P. M., market reports. 9:50 P. M., weather reports covering next 24 hours.

Cincinnati, Ohio. Call letters KDQC. 4000 meters. Daily live stock market reports.

Omaha, Nebraska. Call letters KDEF. 2500 meters. Daily live stock and grain reports.

North Platte, Nebraska. Call letters KDHM. 4000 meters. Daily live stock market reports.

Rock Springs, Wyoming. Call letters KDHN. 3000 meters. Live stock market reports.

Elko, Nevada. Call letters KDEJ. 3000 meters. Daily live stock market reports.

Reno, Nevada. Call letters KDEK. 3000 meters. 10 A. M., live stock market reports.

PUBLIC HEALTH SERVICE

Broadcasts important health information through several of the most powerful private broadcasting stations. Heard from Cuba to New Brunswick and from mid-Atlantic to Nebraska *via* Eastern stations.

tion, expanding his activities in Europe,

Shall We Trust America to Henry Ford?

A Vivid Word Picture of the Master Mechanic, Who Will Tell, in Next Month's Issue, of His Vast Water Power Plans

By Searle Hendee

IN the past year Henry Ford, the man, has become nearly as significant in national affairs as the Ford automobile had previously been. When you read Ford's amazingly far reaching industrial program, outlined by Ford himself in the next issue of *Popular Science Monthly*, you will be glad to have been previously introduced, in the article herewith, to Henry Ford as he is today.

This extraordinarily gripping picture of Ford's life and power reveals a restless genius who, given a few tools like Muscle Shoals, might indeed make himself master of America's industrial future and the prosperity of its citizens.

VISUALIZE a spare, angular, yet singularly graceful man standing slightly less than six feet high; a man about 60 years old who has the alertness and enthusiasm of a boy; a man oblivious of the past and intensely engaged with the present—and you catch a faint glimpse of Henry Ford.

He Can't Be Pigeonholed

Talk with Mr. Ford for five minutes and you will be impressed by the fact that he does not represent a type. Chat with him for an hour, study his various reactions to questions, his movements, his answers and his assertions, and it will dawn upon you that he defies casual analysis. You cannot readily classify and pigeonhole Henry Ford. You cannot say that he is this or that—for he is neither, and he is both.

To expect a word portrait of Mr. Ford to be definite, clear, and true to life would be like expecting a cubist painting to be realistic. Whatever Mr. Ford may seem to be one minute, he is likely to prove himself not to be the next. And, after all, this is perhaps the key to Henry Ford. He is not cut to a pattern, physically or mentally. He does things not by rule or pre-established plan, but by setting out and doing them. Therefore even the panorama of his activities fails to disclose a definite picture of the real man.

In wealth, publicity, industrial leadership, and perhaps even popularity, Mr. Ford occupies a foremost position in America—if not in the world—today. Twenty years ago he was an unknown farm-bred mechanic who was tinkering with a gas-engine and occasionally getting press mention as being a "promising young chauffeur."

A Marvel of Brain Power

A few years ago it was common belief that Mr. Ford's success was attributable to the "brains" in his organization. The light of recent events has shown this to be ridiculous. Tearing his organization to shreds in the hour of crisis, outwitting Wall Street, turning raw materials into money by working his vast plants 24 hours a day when the wheels of industry were gathering rust and cobwebs the world over, accumulating a bank balance of $150,000,000 so quickly that it made his enemies' heads swim, and at the same time experimenting with bread formulas, tinkering with a 1¼-horsepower hydro-electric outfit with which to interest neighborhood boys in water power development, designing a new dual power locomotive unlike anything ever before seen, superintending his 5000-acre farm, completing the largest and most modern blast furnaces in America, contesting the Newberry elec-

From Farm Mechanic to the Richest Man in the World!

A SCAR on the face of Henry Ford, caused by a jagged piece of a bursting teakettle, remains today as the badge of an inveterate tinkerer, with boundless curiosity and imagination, who has conceived and developed the most amazing industrial organization of our time.

By gagging the kettle, Henry learned the power of steam

The youthful, gray-haired Henry Ford, who at the age of 60 is reaching out to dominate America industrially, is the same exploring Henry who as a 10-year-old boy plugged up the spout of an earthenware teakettle with rags and paper, tied down the lid, and watched intently to see what would happen. He got results then with a vengeance, just as he gets them now.

Henry Ford has been a tinkerer ever since he was old enough to wear trousers. In early childhood he delighted in taking watches, clocks, and other machinery to pieces, studying the mechanism and putting them together again. His desire to experiment often led him into trouble. On one occasion, Henry, aided by schoolmates, built a dam across a brook near the school to obtain power for a water wheel. When the water backed up above the dam and flooded farmlands, the schoolmaster ordered the young engineers to destroy the dam.

"When this is done," he told them, "Henry, who is your ringleader, can remain with me after school each day until I tire of his company."

That episode was one of the beginnings of Ford's keen interest in water power that has grown into his present far reaching plans for rural water power and industrial development.

Henry Ford was born on July 30, 1863. His father, William Ford, who had emigrated from Ireland, was a farmer living between Dearbornville and Fort Wayne, Mich., about 10 miles from Detroit.

At the age of 17, a year after completing the eighth grade of school, young Ford went to Detroit and obtained a position with the Flower Manufacturing Company, makers of steam engines. He served his apprenticeship, studying mechanical engineering in his spare time. After nine months he secured a more responsible position with the Drydocks Engine Company, makers of marine machinery.

The illness of his father compelled him to return to the farm, where in leisure hours, he repaired watches, clocks, and farm machinery and worked on the development of a horseless vehicle. In the winter of 1887 he built his first farm tractor from an old wagon body and odds and ends of discarded farm machinery.

The following spring he married Clara Bryant, the daughter of a farmer. After three years on his own farm, Ford went to Detroit to perfect his horseless carriage. He obtained a position with the Edison Illuminating Company and spent his spare time in his home workshop, where he completed his first model in April, 1893. After a successful trial, a company was organized in Detroit with Ford as chief engineer. Ford built a racing car which he named "999."

His first power site on the creek angered the farmers

In the summer of 1902 a new company with larger capital was organized. This company sold its first commercial car that year and 165 cars the following year. Orders came in faster than they could be filled and the factory was enlarged. In 1905 the company began to pay 6 per cent dividends. From that time the Ford enterprise developed rapidly. At present, 4000 cars and tractors are turned out daily, or about one every 20 seconds.

In addition to the three big plants at Highland Park, River Rouge, and Dearborn, which employ more than 66,000 men, Ford owns iron and coal mines, blast furnaces and steel works, a railroad system and more than 30 assembling plants in the United States and abroad. His works have their own power, heating and lighting plants, fire department, telegraph and telephone exchange, freight offices, hospital, motion-picture studio, athletic field, schools, stores and newspaper.

During the war, Ford, although an outspoken pacifist, devoted his gigantic plant to the manufacture of material needed by the Government for war purposes. His profits, aggregating $29,000,000, he returned to the Government.

tion, expanding his activities in Europe, laying plans for the development of Muscle Shoals, experimenting in the commercial production of alcohol, vacationing with Harding and Edison in the Cumberlands, inspiring a weekly magazine, receiving an endless procession of world notables at his Dearborn, Michigan, estate—doing all these and other things far too numerous to itemize, without even having an office in which to transact business or a memo pad to remind him what to do next, Mr. Ford has shown the Ford industries to be the greatest one-man organization in the world.

Simplicity, Plus Power

In the light of these dazzling achievements, it is amazing to find in him a man of manifest simplicity who outwardly seems to shoulder no more responsibility or care than a boy of 14 tinkering with his first watch.

A man of national prominence in a recent interview confidentially referred to Henry Ford as being drunk with power and careening toward destruction. "Ford is obsessed with the same mania that brought ruin and disgrace upon the German kaiser," he asserted.

To me, after seeing the man as he natively is, no characterization could be a greater libel.

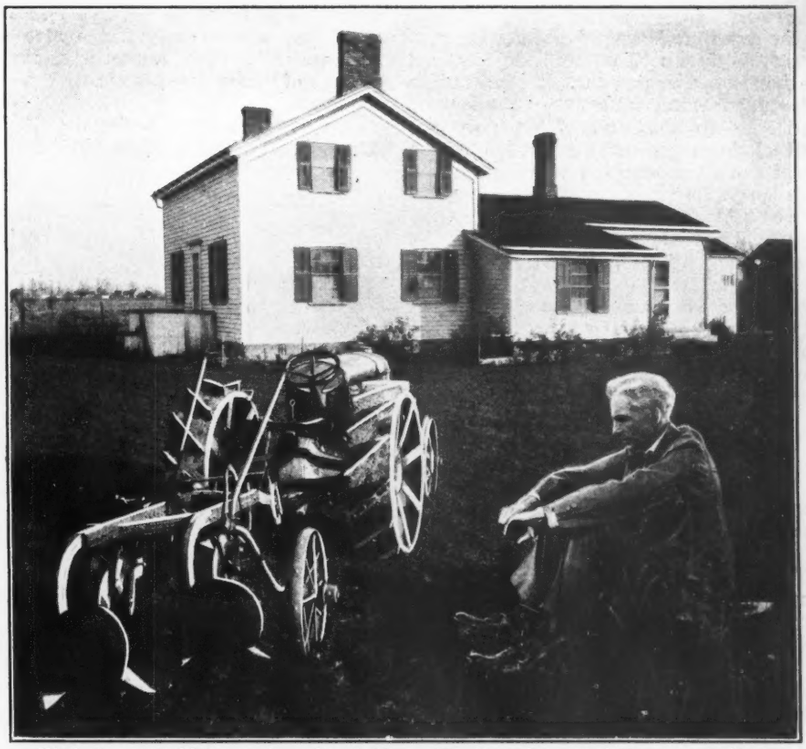
It is true that Mr. Ford is one of the most powerful men in the world today. He is perhaps the only man in America capable of pulling the country up by its boot-straps and rousing it from its present commercial coma. He might even be referred to as an industrial czar, for he exercises an influence vastly greater than is enjoyed by the rulers of many principalities. Yet Henry Ford the individual, as you meet and chat with him, impresses you as being as human and unassuming as it is possible for a man in any walk of life to be. By this I do not mean to imply that Mr. Ford is only partially conscious of his power, or his ability, to do almost anything that can be done through the use of brains, energy, and great wealth. He recognizes no limitation, the "impossible" means only the unaccomplished, and conventional obstacles only serve to encourage achievement.

He's the "Boss" of His "Shop"

This phase of his make-up may be illustrated by a trait that is well known in the engineering department of the Ford Company. Frequently Mr. Ford has a "bright idea." He instructs his engineers to do something which past experience has shown to be an "impossibility." For a few days, or possibly a few weeks, much hard work is devoted on an "utterly useless task." But eventually the engineering staff comes through with what Mr. Ford wants. The "impossible" elements have been circumvented.

Usually it is the history of a big business that its founder gives way to new blood when a certain point is reached. Practically every great commercial and industrial institution—the Standard Oil Company, as one example—bears this out. Mr. Ford, however, is breaking the time-honored rule. He is demonstrating that he is as big as, and can grow fast enough to keep a little bigger than, the institution he has built.

Two circumstances make this apparent. First, Mr. Ford is the "boss" of his "shop." He is father of practically every move the firm makes. He is the Ford Company's inventor, director, and financier. It is because of this that he has never surrounded himself with great men. He insists upon doing his own thinking. Therefore the company has always developed its own talent. Men prominent in the organization have grown up on the inside. Experts are never called in—they are never needed. In fact, it is one of Mr. Ford's convictions that amateurs are better than professionals anyway, because they have the habit of going ahead and doing things through ignorance of the "fact" that they can't be done. The second point is that vast and complicated as are the Ford interests, they are so completely under Mr. Ford's thumb that they neither bewilder nor burden him.



With dreams of his youth realized, Henry Ford, at the age of 60, contemplates the descendant of his early "farm locomotive" on the lawn of his old home near Dearborn, Mich.—and dreams still more—this time of the future production of 1,000,000 farm tractors a year

In becoming possibly the world's richest man, in making himself one of the world's most talked of figures, in building a motor-car plant that annually manufactures more automobiles than all other American factories combined, has Mr. Ford realized the ambition of his youth? Put this question to him and he will answer by telling you that he is going to build 1,000,000 farm tractors a year when he gets "set," or that he is working on a new locomotive. In my case, he invited me to see the locomotive. And after all, what more significant an answer could he give? In Mr. Ford's mind, the work he has thus far accomplished is preparatory to what he is going to do.

"Where Are We Going?"

Just what is Henry Ford getting ready to do? This question may naturally follow. And imagine the start one receives, after putting this very question to Mr. Ford, to have him reply by asking in turn: "Where are we going?"

I do not think Mr. Ford was consciously quoting Gerald Stanley Lee. Nevertheless to hear these words issue from his lips makes the query far from enigmatic.

In Mr. Ford's success there is much to inspire any one whose bent lies along mechanical, industrial, or scientific lines. His beginning was neither in poverty nor affluence. As a farm boy he was the son of plain people of moderate circumstances. His interest, however, was not in following a plow hour after hour, or in doing other characteristic farm labor that offered no opportunity for exercise of the brain. So, in a small barn on the Dearborn, Michigan, farm, he began working on a "farm locomotive." This led to the development of the present Ford motor-car and tractor.

Concentrating on the Tractor

Realizing that the automobile must prepare the way for the tractor, he concentrated his attention on it. And now, after having built the world's largest motor car plant, and after constructing some 200,000 farm tractors and placing them in service, he is "getting ready to *manufacture*" tractors.

With these facts in mind, I asked Mr. Ford to outline briefly some of the points in his life which he considered significant. The conversation in its brevity and wording is entirely characteristic of Mr. Ford when replying to questions of purely personal nature.

"The past doesn't mean anything now. Today is what we are concerned with."

"But," I remonstrated, "in your early ambitions and struggles, and in the way you overcame your problems, there must have been much that would be significant to many a young fellow today. What single thing would you impress today upon the minds of young men who are apt to make a fairly determined fight for success during the next generation?"

"I'd tell them to spend their money on themselves."

"What do you mean by that?"

"I mean that this savings bank idea is

fine for the bankers, but no good for any one else.'

By this time Mr. Ford was getting restless. He likes a "snappy" interview, and this one was dragging out. He walked into his experimental laboratory, stepped up crosswise to the seat of an armchair, settled down grasshopper fashion on his heels and gazed into the transmission case of a Ford motor resting on a block in front of him.

"What is money good for, anyway?" he continued. "It is no better than the use made of it. And you are not making use of it if you stow it away in a bank so that some other fellow makes money loaning it to a third person who puts it to work.

Money for Happiness

"Tell the young fellow to spend his money on *himself*. Get that last."

"For instance!'

"If a boy wants a book and has the money with which to buy it, he should go ahead and get what he wants."

"You mean that he should use his money for self improvement and advancement."

"And happiness. Don't forget that! That's the only way to get ahead. If a boy's old suit makes him look like a failure, he needs a new one a whole lot worse than he does a $50 savings account."

"When should he borrow?"

"Always borrow when you don't need money."

"Thereby building up credit?"

How to Keep Out of Debt

"No. If one never borrows except when he doesn't need money, he will never get in debt, because he will never borrow."

"Then you don't believe in the plan of 'saving' by making instalment payments apply on an investment."

"You are referring to a young fellow buying a home. Well, if he makes it a practice not to buy anything until the necessary money is in hand, the home can be purchased by the time he needs it."

You will recall that during a certain famous trial Mr. Ford asserted that he had never spent time studying history because history deals with the past, whereas he is concerned with the present. In general conversation he has a way of pushing aside references to past experiences as being irrelevant. And therefore it is not surprising to find him consistent to the point of feeling that his own history can be of little help to the coming generation. Mr. Ford's early life is more or less an open book, however, and there is no doubt that as much, if not more, of real interest is to be found in the man of today as in the boy of yesterday.

Among men associated with him it is difficult, if not impossible, to find any one who will admit that he "knows" Henry Ford. Seek such a man and you will be convinced that few men have a deep insight into Mr. Ford, whereas Mr. Ford apparently has the faculty of "knowing" practically every one he meets.

His power of remembering detail is well illustrated by an incident that occurred early in his life and that has a direct bearing on his present activities. As a youth he spent much time reading semi-technical publications. In fact he still does, and shows a preference for magazines of the type of POPULAR SCIENCE MONTHLY. In one of these publications he found an illustrated article that described the Ott (illuminating gas) engine—at that time a new invention. A few years later one of these engines was imported from Europe by a Detroit man. After it had been in operation a short time, something went wrong and no one could be found who was able to start it. Finally Henry Ford was called upon. Although he had never seen such a contrivance before, his memory retained so vividly what he had read that he "knew" the motor before he touched it. In a few minutes the engine was running smoothly. Shortly afterward he began experimenting in the development of a gasoline motor—with the result we all know.

Old timers around Dearborn have a Ford gas-engine story for every occasion. And if these tales are authentic they show a remarkable affinity between Henry Ford and gasoline engines. Balky motors, motors that simply won't run, motors that have defied expert mechanics for hours, begin purring as melodiously as a family cat when Mr. Ford lays a hand on them. It is said that he rarely seems to do more—that to all appearances he does nothing at all—but that a motor is always full of life when he turns it over.

It is well known that Mr. Ford is a man of strong likes and dislikes. If a thing is distasteful to him, it is very distasteful. This phase of his character has caused the impression to go forth that at times he manifests pronounced vindictiveness. The word is misused.

Ford at the age of 30 in his first "horseless carriage," which he developed during spare hours in his home workshop

When Ford Revolts

For instance, there are certain established systems in political, commercial, and social fields against which Mr. Ford revolts. Manipulation, exploitation, and similar terms are not pleasing to him. And when he makes up his mind that a condition or movement is wrong, he is likely to let some one know about it. For this reason Mr. Ford shows little love for a certain class of bankers, professional financiers, professional politicians, and certain big interests. There is good reason to believe, indeed, that in his willingness to take over the Muscle Shoals project, Mr. Ford is animated not entirely by a strong personal desire to control the enterprise. There are interests, however, for which Mr. Ford has contempt, and in order to prevent their plans of exploitation he would give almost anything to gain control.

Concerned for the Public

I was with Mr. Ford when he first learned that a movement had been launched which might lead to the state of Alabama taking over and operating Muscle Shoals.

"That's a fine idea," instantly shot back Mr. Ford. "We are for that. We are ready to help any plan that will save Muscle Shoals to the people." He then began to unfold an interesting plan whereby the state might finance the venture.

Incidents of this sort frequently cause Mr. Ford to be referred to as a humanitarian and benefactor. Such terms annoy him. He is in the habit of doing what seems to him at the moment to be the right thing to do—the thing that fair-dealing and straightforwardness seem to demand.

To summarize briefly these few sidelights on America's outstanding industrial leader: Mr. Ford has no office, no job, no working hours. He is everywhere at once, thoroughly aware of everything that is going on in his plants and elsewhere—a man whose mind is a veritable pinwheel of worth while ideas, a man who makes play of his work, who abhors waste, idleness, dirt, and drudgery.

"Tune In" for Ford's Message to You

"FORD'S is a marvelous program. It is one of the greatest I have ever heard of," says Thomas A. Edison.

"He sees the nation, far and wide, simply dotted with little centers of water power development. Wherever there is a stream, a waterfall, a rapid river, there will be a hydro-electric plant, surrounded by the wealth and beauty of the open country. Then fewer of us will live in the slums and soot of the city. More of us will be tilling the soil, raising crops, and earning money in between times in the local factories."

Thus Thomas A. Edison, in an interview in POPULAR SCIENCE MONTHLY last month, characterized Henry Ford's program for establishing numberless little industrial agricultural centers all over the country.

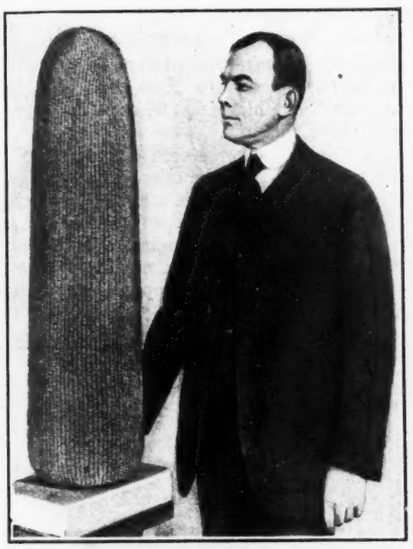
The accompanying article gives you a closer acquaintance with Henry Ford, the industrial giant who, in the next issue of POPULAR SCIENCE MONTHLY, tells in his own words the details of his vast water power projects.

Plane Makes Landing Automatically

LANDING an airplane solely by mechanical means while the pilot's hands are off the control stick has been accomplished by means of a device perfected by Lieutenant Noakes, a British army flyer and specialist in low speed maneuvers.

A long arm is pivoted to a cross member behind the axle of the landing gear, and is connected with the bottom of the control stick by a strong elastic cord. As the plane approaches the ground, the stick projects downward. When its end strikes the earth it automatically pulls back the control and "flattens out" the plane.

By knowing the air speed and engine revolutions at which to glide in, and the moment to throttle down—which is indicated by the ground stick when it pulls back the control—the aviator can make a perfect landing almost automatically without touching the control stick.



If You Could Only Grow Corn Like This!

CLEVER nature faking, not superfarming, is responsible for the largest ear of corn in the world, exhibited at a recent agricultural show. The giant ear looks as if it might have grown on a stalk, but as it is 37 inches long, and contains 82 rows of 225 kernels, or a total of 18,450 grains of corn, any farmer finding one like it in his fields would be in danger of heart failure.

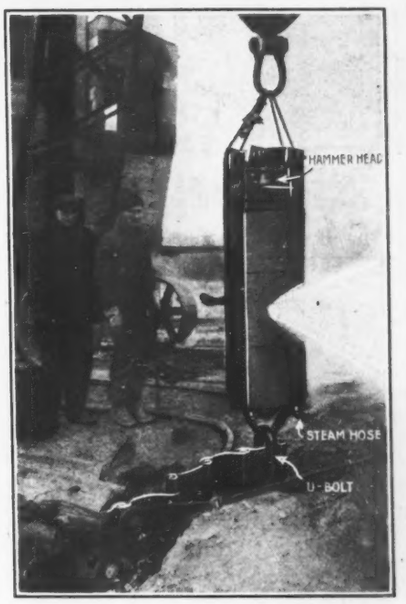
The ear was manufactured by laboriously gluing each kernel to a papier-mâché cob.

Comfort for the Cyclist in Stormy Weather

A NEW type of motorcycle windshield that protects the rider almost completely from dust and rain and makes it possible to tour comfortably on two wheels, is made of a single sheet of thin aluminum, curved roughly to conform to the sweep of the handle-bars and the front forks and with its upper section pierced by a celluloid window. This window slides vertically, and may be opened or shut as desired. The sides of the shield are cut away to permit ready access to the gas tank, affording freedom of movement.

The shield protects the rider from head to foot

Small semicylindrical legshields also protect the rider's legs up to the knees. In a preliminary test a motorcycle thus equipped was driven 50 miles through a winter storm. Hardly a speck of mud touched the driver.



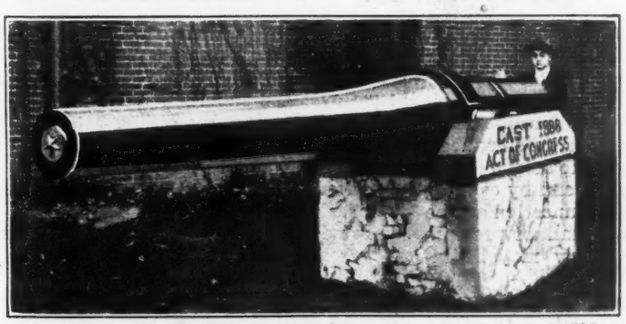
Steam Hammer Pulls Pile from Frozen Ground

PULLING a 20-foot pile out of the ground with a steam hammer was the task accomplished recently by a contractor of Detroit, Mich., when the usual method of pile removing had failed.

After the derrick had proved itself powerless to budge the pile, the steam hammer was reversed, so that it struck upward. A three-quarter-inch steel cable was passed around it four times. This cable also passed through a U-bolt attached to the pile, and the derrick was fastened to a sling threaded through the head of the hammer.

With the derrick pulling full force, the hammer delivered several short, quick blows on the tightened cable. The pile was raised several inches. This broke the grip of the frozen ground, and the pile was then removed by the derrick alone.

Here's Uncle Sam's First Cast Steel Gun



THE first successful cannon made of cast steel in the United States, weighing 11,000 pounds, stands today in front of the foundry that made it, as a landmark in the development of steel.

Today cannon are made from forged steel.

Microbes 2000 Years Old

MICROBES over two thousand years old have been found in papyrus of the time of the Ptolemies. These organisms lay inactive for centuries yet were found to be virile and quick to multiply when sown upon gelatine.

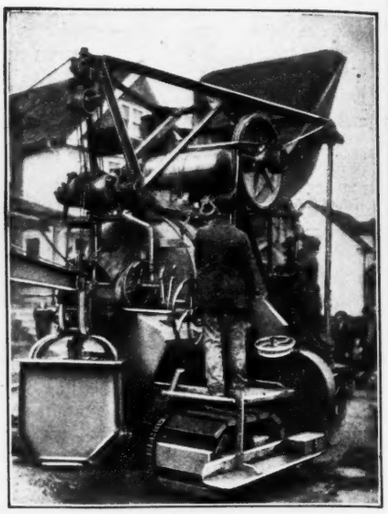
"Dogmobile Tour"—Latest Model

ONE dogpower is the rating of a home-made auto conceived by Coy Watson, Jr., a 10-year-old boy of Los Angeles, Calif., who motors about town in a car propelled by a Belgian work dog. The patient animal operates a treadmill concealed in the large hood and with the aid of gearing drives the car at a very fair speed.

Dogs of this breed are trained as work animals in Holland and Belgium, and the treadmill is no novelty to them. Coy's dog enjoys the ride nearly as much as his young master, who finds it easy to avoid "engine trouble."

Four stout legs of a Belgian work dog, running a treadmill, supply the motive power

Continuous Tread Stops Jars on Cement Mixer



A CONTINUOUS tread mounting for the portable cement mixer is said to eliminate harmful vibration and to produce increased speed. It also eliminates the necessity of blocking wheels or laying planks for the unit.

A 10-horsepower steam engine supplies the power, and all the operating levers are under the control of one man. The raising and lowering of the hopper and the travel of the bucket on the swinging crane is automatic, as in most modern mixers, but they can also be operated independently if desired.

The rate of production of concrete can be controlled by a touch of the levers.

Train Plants Phone Poles in Roadless Country

PLANTING 50-foot telephone poles with a railroad train was the original method adopted by W. H. Bolling, estimate foreman of a Southern telephone company, in building a line between north and south Bogalusa, La.

There was no wagon road over which he could haul the poles and it seemed impossible to get them on the ground, to say nothing of erecting them.

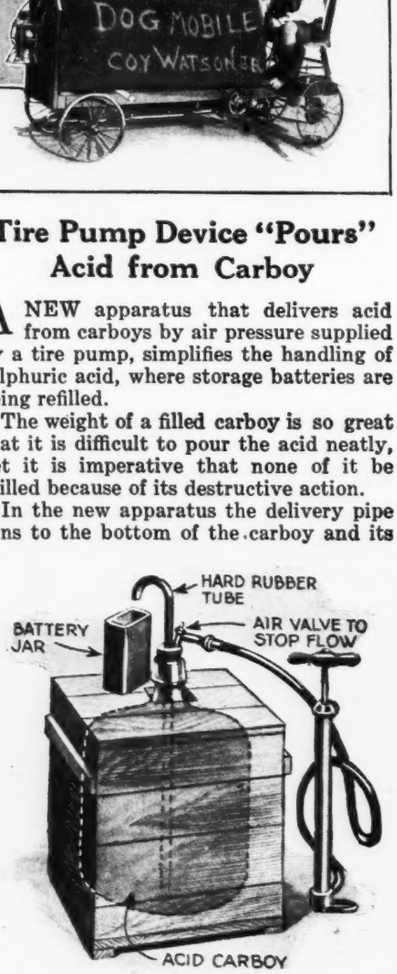
He sent out his construction gang and dug a line of post holes along the railroad track, and then started from Bogalusa with a work train consisting of a flatcar carrying the poles, the log loader, and an engine. Reaching a posthole, the loader lifted a pole off the car, lowered it into place, and held it while the gang shoveled in the dirt. The method proved a great time saver.

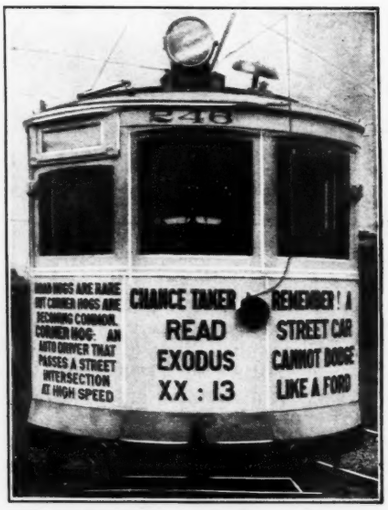
Tire Pump Device "Pours" Acid from Carboy

A NEW apparatus that delivers acid from carboys by air pressure supplied by a tire pump, simplifies the handling of sulphuric acid, where storage batteries are being refilled.

The weight of a filled carboy is so great that it is difficult to pour the acid neatly, yet it is imperative that none of it be spilled because of its destructive action.

In the new apparatus the delivery pipe runs to the bottom of the carboy and its discharge end is curved downward. This pipe passes through a special cork or plug to which is attached the air tube connecting with the tire pump. The acid is drawn off by operating the pump, and by opening a relief valve in the air connection at the cork, thus releasing the small air pressure within the bottle, the flow may be instantly stopped.



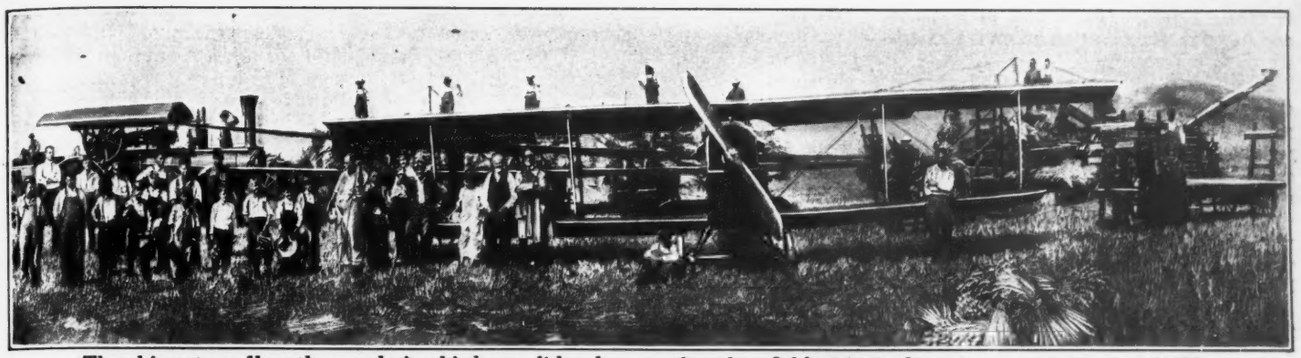


Novel Safety Car Warns Reckless Drivers

PAINTED white and covered with safety slogans conspicuously displayed, a "Safety First" campaign car makes regular runs over the suburban trolley lines near East St. Louis. By calling attention to the dangers of reckless driving near the trolley tracks, the use of the car, it is reported, has already reduced the number of accidents.

Previously there had been collisions between autos and trolleys every day, resulting in heavy damage claims.

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly



Threshing stops when the wandering birdman slides down to the wheatfield with the first plane seen in the township. Some gipsy flying outfits like that above make $100 a week, introducing aviation to America's rural regions

Profits and Adventure in the Gipsy Flier's Life

Exciting New Profession of Sky Rovers, as Described by One of Them, Is Rousing America to Commercial Flying

By M. W. Royse, of the Aero Club of America

HERE'S the story of a gipsy flier—one of the most romantic figures in American life today. Members of his profession, nearly 200 strong, are this summer soaring far and wide over the backwoods and small towns, spreading the gospel of aviation to communities where a birdman never hovered before, and earning their living as they fly.

These are the pioneers in the cause of commercial flying. In next month's issue, Glenn Curtiss, pioneer of pioneers, the man who has made a fortune from commercial flying, will tell of the young man's opportunities for a career in aviation.

AT the Omaha air meet last year a row of airplanes stood parked in one corner of a field. They were not on display, for most of them were service planes—rough and hoary veterans of the air.

The row of planes grew as late arrivals swooped down upon the field and drew up alongside. Spectators wondered to whom these planes belonged and for what purpose they were to be used.

The mystery was soon solved. They were gipsy ships, belonging to a band of youthful gipsy flyers who had drifted into Omaha for the big air meet. Some had traveled all the way from Texas, others from New York, some from Florida, and still others from California—a trifling distance in their young lives.

The gipsy flyer—roamer of the air, and pioneer of commercial aviation in America—is a newcomer. He made his advent less than three years ago, but he has already made great progress. An aviator during the war, he naturally turned to civil flying for a profit after his discharge from the service, and in the brief period following he has covered every state in the Union, earning his living by carrying passengers and freight wherever opportunity offers. He has brought aviation home to millions of people who before his coming had never seen an airplane outside of print, and he has carried thousands of passengers for their first thrilling flights through the air.

Pilot and "Mech" Show Teamwork

A gipsy ship generally carries two men, the gipsy flier and his mechanic. The pilot handles the flying end of the business and his "mech" takes charge of the plane on the ground. They cooperate, the pilot often helping his "mech" on the motor repairs and the mechanic doing his best to coax indifferent spectators into taking a hop. Sometimes a gipsy ship carries two fliers, each taking his turn at flying and ground work.

The methods of the gipsy fliers are not limited to any set formula. Each gipsy has his own peculiar methods, but some practices in the profession are common to us all. For instance, we usually start out with a nicely prepared itinerary. We lay out air routes, mark prospective towns to be visited, with dates of arrivals, and note towns with established airdromes.

These plans, however, often miscarry and for good reason. Some towns that look good on a map turn out to be dilapidated old boom towns; other districts have been covered by previous gipsies, and still other portions of the country are inaccessible because of woods or other natural obstacles. A month after starting, the average gipsy may be 300 miles from where he planned to be—all of which makes the game interesting.

The gipsy proceeds carefully. Upon reaching a town he hovers over it, observing its size and its layout, and determining whether there is an accessible landing field close by. The size of the town is important, for most of the larger towns have been visited by gipsies, and although work can still be found in these, the average gipsy prefers virgin territory. Small towns under 3000 population, often under 300, are the ones picked in this advanced stage of the game.

He Should Land Close to Town

If the gipsy's visit is to be a successful one, the landing field should never be more than a mile from town, preferably at the outskirts and available to motor cars. A New York town, in the Adirondack country, refused to take advantage of gipsy visitors because they made use of a field over a mile distant, with only a cowpath as a road leading to it. A more determined gipsy, however, slid into a baseball park on the edge of town, and carried 14 passengers in a half day. Another gipsy, in Pennsylvania, having learned from experience that people will not patronize even an airplane off the main road, landed on a hillside and carried passengers from its slope rather than remain idle on a level field half a mile away.

The ideal landing field is one facing the main street of a town. Such fields can often be found in the West. Busy merchants, farmers, and laborers are willing enough to stroll a block or two for a ride in the air, where they would refuse to walk a mile.

Once the gipsy decides to land in a town, he attracts attention by sailing down low, buzzing over tops of buildings, and disturbing the inhabitants. He wants to make sure that the natives know of his arrival. Next, he swoops down to the field, taxis alongside the road, and is ready for business. A crowd usually gathers as soon as he lands and both pilot and "mech" are kept busy answering questions.

The Crowd Needs Persuasion

The next move, highly difficult, is to induce some one in the crowd to fly. Some pilots make special reductions for the first hops. Others give extra long rides—"test hops" they call them—and still others give free rides as a starter. One gipsy made a practice of offering the mayor of each town a free ride. If the mayor refused the invitation, some other prominent citizen was honored, preferably a minister, for publicity purposes; a doctor or prominent merchant as a last resort. Gipsies find people will fly more readily in a two-passenger bus. Most persons prefer company on the first flight.

During the first two seasons of gipsy flying, ex-service planes were used almost exclusively. The "Curtiss," the "Standard," and the "Canuck"—all service planes of one-passenger capacity—were cheap compared with the cost of new machines, and many were remodeled into two-passenger buses, sometimes with the same motors and often with more powerful

takes unusual pains to establish himself as

been given the impression that flying is still

To these people he is aviation itself, the

motors. Equipped with tool kits, spares, and luggage, they started off on their barnstorming careers.

Naval "F" boats gave good service, carrying four passengers at one time. These were used with great success in the lake regions inaccessible to land planes. Northern Wisconsin, as well as northern Minnesota, saw its first gipsy when a flying boat arrived in port. The same was true along the St. Lawrence River and around the lakes in northern New York.

Some gipsies have gone in for more powerful planes, and with these they have invaded towns beyond the reach of the average pilot. Vermont, especially the Green Mountain country, remained virgin territory until late last summer, when an enterprising young native of that section gave up his furniture business and turned to aviation. With the help of the Aero Club of America, he managed to find an efficient gipsy for a partner, and to purchase an airplane suitable for rough country.

How He Succeeded

His problem was to slide into small fields and to get out of them again with short take-offs. Only a powerful motor could be depended on to do this with certainty, for failure to climb rapidly might result in a crash into trees, a telephone pole, or a hillside. These conditions kept gipsies who operated low powered buses out of that district, with the result that the ex-furniture dealer with his high-powered machine found more work than he could handle. He now owns two planes, both of which, no doubt, will find enough work to keep them in the air most of the time.

Passengers are often shocked at the high prices charged by gipsies. They feel that $10 is an exorbitant price for a 10-minute hop. But they do not consider the great overhead and operating expenses of the gipsy outfit. The gipsy, it is true, earns fair returns, but at the same time the passenger is nearly always given his money's worth. Some pilots have been known to cut down on the passenger's time, but such cases are few, and the pilots soon learn that it pays in the long run to give each passenger his full measure.

One Dollar a Minute

There are several sources of income for the gipsy flier, but he depends chiefly upon passenger carrying. Today the average rate for flying is one dollar a minute for a 10-minute hop. A pilot working steadily, with the cooperation of an efficient mechanic, manages to make four hops an hour. There have been instances of gipsies carrying 35 passengers in eight hours of flying, but these are exceptionally "big" days. Many pilots carry 25 passengers a day, but not regularly day in and day out. A gipsy carrying 100 passengers a week is doing enormous business. A conservative estimate of the amount of business done by the average gipsy the country over would run around 35 passengers a week, considering time lost by bad weather and other delays.

The flying season usually lasts about 26 weeks—from late spring to late autumn. Some idea of a gipsy's weekly income may be obtained from the following table, the estimates being based upon a 26-week season with an average business of 35 passengers a week.

Income, 35 flights a week at $10	$350
The weekly expenses as follows:	
Gas consumption, 10 gallons an hour, at 40 cents a gallon	32
Oil consumption at one dollar a gallon, one gallon an hour	8
Gas, for travel and waste, 20 gallons	8
Oil, for travel and waste, 2 gallons	2
Mechanic's wages, a week	35
Pilot's wages, a week	75
Expenses, living, for pilot and mechanic	60
Insurance on $3000 (cost of the average ex-service plane), at 18% for six months	20
Overhauling engine, every 100 flying hours, by commercial aviation company (Most gipsies attend to their own motor overhauling except for a complete overhaul twice during the season)	12
Plane and hull redoped and revarnished, once a year	5
Depreciation and replacement	60
Interest on investment, $3000 at 7%	8
Total, overhead and operating expenses	$325
Total gross income, from passenger work exclusively	350
Net profit, excluding wages of pilot and replacement of new ship	25

The $25 net profit a week from passenger work alone is a fair profit when it is considered that the gipsy has already paid himself a weekly wage of $75 for his own services as pilot, paid the interest on the $3000 investment, and placed in reserve a weekly replacement fund of $60, which will amount to the price of another $3000 ship at the end of two flying seasons. He has also allowed himself living expenses, so that the $25 is clear velvet to him as owner and operator of the enterprise.

Some pilots fail to lay aside a replacement fund, in which case the weekly income amounts to $85.

Many pilots have bettered this estimate of income; some have tripled it, others have fallen below the average, and a few have even lost money: but the average pilot has managed to finish the season with at least $1000 clear profit, with an additional $1500 laid aside toward the purchase of a new plane.

Sources of Profit

Income depends upon caution in flying, care of machine, general management and luck. The best of managers sometimes finds himself making little headway, due to petty misfortunes. Incomes differ with territory. In the Middle West, pilots are still charging $15 for a flight, while in California and in Florida pilots are known to have carried passengers for $5. To be sure, $5 flights are of only five minutes' duration, but the time lost between flights makes a distinct difference in the net profits.

Last winter was a dull season in Florida, due to the fact that pilots from all over the country congregated there to combine pleasure and profit. Nearly 30 gipsies located along the narrow strip of beach from Daytona to Miami. Daytona alone harbored 10 of them. During the same winter months, however, three gipsies were kept busy continuously, from early morning until sunset, carrying passengers off the ice in the lake region of Minnesota and Wisconsin, at $15 a flight.

Gipsies Usually Begin at Home

Pilots who start out nowadays usually begin in their home states, charging the rates prevailing in their particular section of the country, and operating conservatively. Within a month they become accustomed to the game, and may be 400 miles away in fresh territory. But this method will soon be obsolete. Pilots already realize the necessity for localizing their sphere of operations. Immediate profits may be increased by barnstorming the country at large, but experienced gipsies are now looking for more permanent fields. They are slowly realizing that it is far better in the long run to cover 100 miles thoroughly and efficiently, than to barnstorm 1000 miles in a hit-or-miss way.

The gipsy who decides to limit his sphere of operations, first chooses a site for his headquarters, usually the central and most important town in a district. From this base he covers the country for 100 miles around, working for a reputation. He

Does the Sky Gipsy Stop at Your Town?

Here is an ideal landing field. Note the circular marker and the wind indicator flying above the airdrome

IN a few years the town without an aviation landing field will be like the village that sleeps "ten miles from the railroad." The gipsy fliers of today are the pioneers. After them will come the regular airplane routes, with scheduled flights, that will soon cover the United States like a network.

Will your town be one of the air stations—or will you watch the planes pass overhead? A municipal landing field, built now, will bring the speedy, luxurious air expresses of the future to your door.

At present there are only 115 permanent fields, and a thousand emergency fields—mostly golf-links and baseball diamonds—in the country. The future air roads will necessarily follow the landing fields.

A smooth level field, at least 600 yards square, where the ground is firm under all weather conditions, marked with a white circle three feet wide and 100 feet in diameter, and with a wind indicator flying in one corner—these are the essentials.

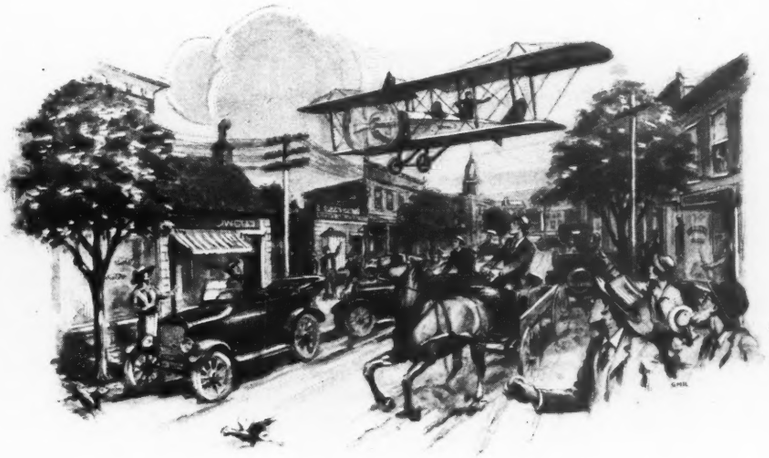
If possible, the field should be close to transportation facilities, both for passengers and freight. Electricity and water power should be available, as well as gasoline, oil, and shop facilities. The hangar and machine shop can be added as the field develops.

The present urgent need in the growth of American aviation and incidentally your own town is for a smooth, level field—a permanent station for the advance guards of the transcontinental airliner.

takes unusual pains to establish himself as a conservative commercial pilot, takes advantage of every medium of publicity, and goes in for many side lines, such as aerial express, aerial advertising, and aerial photography. No commission is too small for him. He accepts work that nets him no immediate profit, for the sole purpose of establishing himself as an integral factor in the commercial life of the community.

Gipsies, however, must take their schooling in the open country, traveling the gipsy trail without limiting themselves to particular localities. This first step is essential to successful commercial flying. The gipsy, winging his way over the country at large, either becomes expert in the handling of his craft, or learns that he is not fit to become a pilot.

There is no harder school of experience than the barnstorming school. Flying across country, over hills, badlands, woods, swamps, and lakes, landing in all types of fields, under all conditions, the gipsy becomes preeminently fitted for commercial aviation. He has run into all the difficulties likely to be encountered in the air. He has flown in rain, snow, and wind. Cloud and fog are no longer terrors. A bank of innocent white mist, far off on the horizon, flashes instant warning to him of a possible fog formation, and he is on the alert for it.



When a gipsy decides to land in a town, he swoops low, buzzing over the tops of buildings and arousing the entire community

Air Gipsies Are in Demand

The last season showed a decrease among gipsies, due to the movements among the old timers, who are gradually entering the commercial field in permanent localities. Commercial companies are on the lookout for these men. At the end of the 1921 season there were 170 gipsy ships in the entire country. New recruits have been filling the vacancies left by gipsies who have moved up into commercial flying, but lack of flying schools has resulted in a decrease in the total number of active gipsies.

This little band of gipsies, small as it is, piled up a record that compares favorably with the best European records. Eighty-eight aircraft companies, operating in the United States during 1920, are reported to have carried 115,163 passengers for a total distance of 3,000,000 miles. The gipsies far surpassed this record. During the same period, the 200 gipsies carried over 210,000 passengers for a total of over 4,300,000 miles. Hardly any of the gipsies had large, smooth fields at their disposal, and most of their passengers were carried from improvised fields alongside hillsides, in swampy ground, or from plowed fields.

Unfortunately, the gipsy sometimes becomes known to the public through an accident. Newspapers have at times placed undue stress upon airplane accidents, with the result that the public has been given the impression that flying is still dangerous. Estimates of casualties for the past year, however, include very few fatalities, and during the last six months of 1920 only one gipsy crash resulted in deaths—a remarkable record when it is considered that over 210,000 passengers were carried under all conditions.

Such accidents as have occurred emphasize the drastic need in this country for landing fields. Aviation to-day is in exactly the same position as the automobile industry was before the "good roads" movement began. The gipsy flier, roaming about the country, must blaze his own trails, find his own fields, and take the chances of the pioneer.

In July, 1921, there were but 115 permanent airdromes and seaplane stations, and 2400 municipal, commercial, and emergency landing fields in the entire country—and the greater proportion of these were located in the more congested parts of the country. The state of New York, for instance, contains 28 commercial fields, four government fields, six aerial police fields, 19 municipal fields, and 58 emergency fields. But even in New York, especially in the northern section of the state, the gipsy still covers long stretches of bad territory without a semblance of suitable landing grounds.

No commission is too small for the gipsy in establishing "goodwill." This pilot and his "mech" are delivering a pig shipped by air from a neighboring farm

The need for landing fields is the prime need of aviation today, and the gipsy, reaching all communities, brings home this need to millions of people who otherwise would never come in contact with aviation. To these people he is aviation itself, the romantic pioneer aviator welcomed in all towns as the representative of the flying industry. Many a town has provided itself with an emergency field as a direct result of a gipsy visit and some have prepared municipal fields.

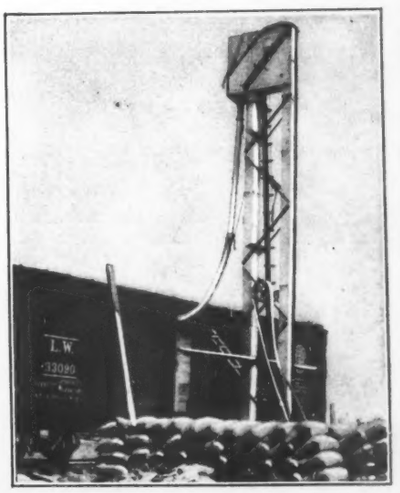
With commercial aviation nearly at a standstill as far as passenger-carrying work is concerned, the gipsy continues to carry on, always seeking new country, always on the wing.

He Stimulates Interest

Tomorrow the gipsy flier may lay aside his traveling kit and confine himself to local commercial flying, but new gipsies will take his place, striking out for the thinly populated districts, learning their lessons, gaining their experience, and in their turn entering the commercial field.

The gipsy continues to beat his independent way through the air, relying upon no one but himself, accepting little assistance from the world while he prepares the country for the new age of commercial aviation which is just appearing on the horizon.

Skeleton Towers Load Grain Cars Quickly

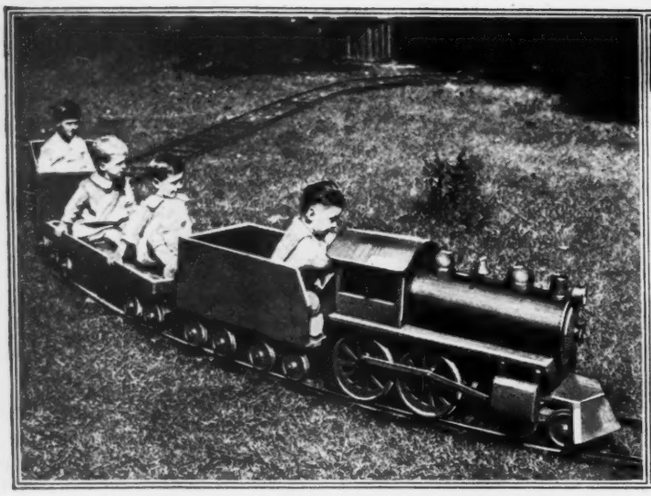


SKELETON towers that will receive grain from wagons and railroad cars as rapidly as the most elaborate grain elevator, have recently been perfected to provide an inexpensive equipment for loading bulk grain on out-of-the-way sidings.

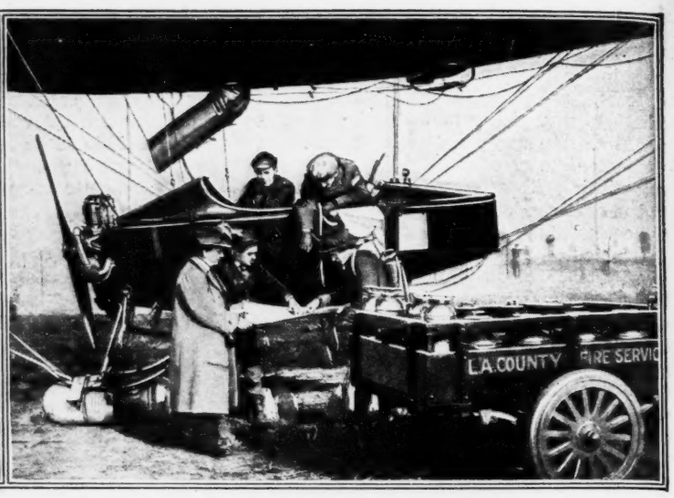
The tower has neither storage capacity nor provision for cleaning the grain, but it will load from 1000 to 2000 bushels an hour.

When in operation the grain is dumped—a truckload at a time—into a concrete receiving pit. From there it passes through a regulating gate into the elevator boot. Here it is picked up by a bucket and belt conveyor and lifted to the elevator head, from whence it falls into the boxcar.

The loading spout ends in a flexible canvas tube that is thrust through the car door and used like a nozzle to distribute the grain equally to all parts of the car.



The backyard gives right of way for this toy railroad

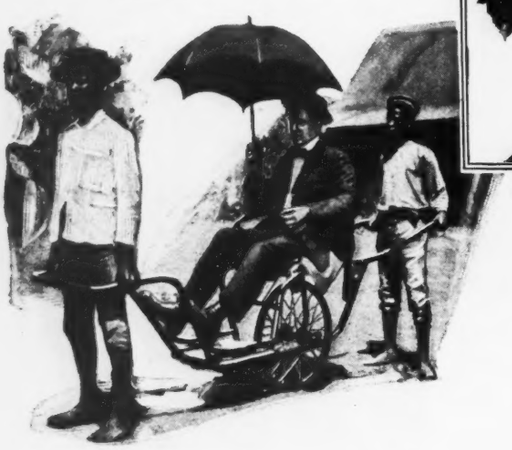


The blimp fire patrol, preparing for a 300-mile cruise

Electric Toy Train Carries Backyard Travelers

BACKYARD railways are growing out of the toy size. The latest model is run by an electric motor, and is big enough to carry a young engineer and all the kids in the neighborhood.

The current is carried in the rails, which are insulated from the ground by wooden ties. The motor is of low power and little current is used, so that running the train is comparatively inexpensive and it is impossible to increase the speed to a point where an accident might result on the sharp curves.



East African Limousine Is One-Wheeled Chair

IN Portuguese East Africa a one-wheeled roller chair is the acme of luxury in travel. It is the mark of the wealthy man, who seeks his comfort and travels in state, without caring a continental for expense.

Man power is cheaper than gasoline in that part of the world, and good roads, even good footpaths, are so scarce that more than one wheel would be useless. Over the jungle trails the traveler is carried by his bearers for the greater part of the distance. Only when nearing a village can the porters lighten their load by resting the wheel on the ground.

ONE of the the largest underground pumping plants in existence has been installed in a South African gold mine. It has a capacity of 8,000,000 gallons a day against the extremely high head of 2600 feet.

Courtesy American Museum of Natural History

Whale Headed Stork Links Two Families

THE whale headed stork, found in Egypt, in the papyrus marshes of the Upper Nile, is an interesting "link" between two bird families—the stork and the herons.

In appearance it is a gaunt, gray figure, standing nearly five feet high. Its huge bill similar in shape to a whale's head, is tipped with a formidable curved beak.

There are only five specimens of this bird in America, the fifth, pictured above, having been added recently to the exhibits of the American Museum of Natural History in New York City.

Sea Lion Is on Trial

THE sea lion is on trial for his life before the Bureau of Fisheries. He is charged by salmon canners with feeding upon salmon, destroying millions of dollars' worth of food fish annually.

But the sea lion is making an able defense. He is of commercial value, and while he eats some salmon, investigations disclose that he also feeds upon the salmon's enemies. The hair seal likewise was once charged with salmon killing, and almost wiped out before the Bureau discovered his chief food w s not fish.

Pony Blimp Helps Fight Forest Fires

A PONY blimp, or small dirigible, is successfully helping airplanes and forest rangers keep down fire losses in the forests of Los Angeles County, Calif. The dirigible carries a fire fighting crew of three, and can land them in any small clearing near the fire. If sparks are flying, the crew is landed by a rope ladder while the blimp remains in the air to windward, where it stands by, waiting to pick up the fire fighters.

The cruising range of the machine is about 320 miles.

Here's the First Woman Marine Engineer

FOR the first time in the annals of the sea a woman has become boss of the "black gang" on a seagoing ship. A license as a marine engineer has been granted to Mrs. Carlia S. Westcott, of Seattle, Wash., and she is now at work as chief engineer on a seagoing tug—no easy berth, as any sailor knows.

Mrs. Westcott declares that women are particularly well fitted for steam engineering, since the work is light, and the chief requirements are watchfulness and close attention to duty.

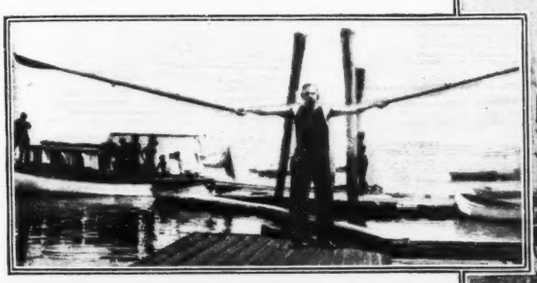
"Women make capable steam engineers," says Mrs. Westcott, and proves it

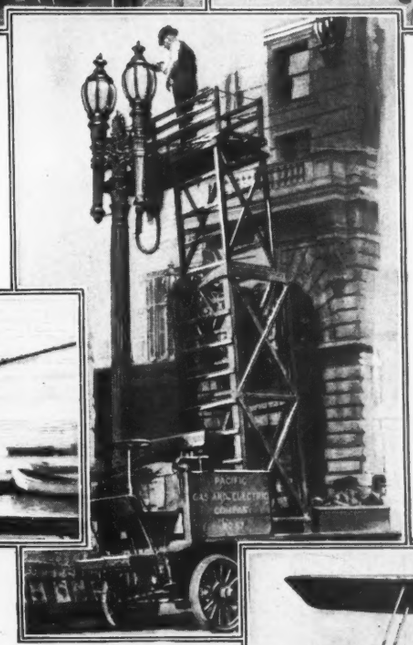
On the Stone Slabs Below will be found
The TRACKS of the DINOSAUR
MAMMOTH ANIMAL OF THE PREHISTORIC AGE.
Holyoke Chamber of Commerce.

© Keystone

Sign Marks Dinosaur Tracks

THE footprints of a dinosaur, made in the mud millions of years ago and hardened to stone, have recently been uncovered on the bank of the river near Holyoke, Mass. A billboard picture and description now supply information to passers-by concerning the creature.





How to Dance on Swords

HOW do Hindu street jugglers dance upon sword blades, whetted keen as razors? They step about the lattice of steel in perfect time to music, and when the dance is over there is not the slightest cut on their foot soles.

The secret lies in the fact that the blade of a sword is not perfectly smooth. Under a microscope a knife-blade looks like a saw. It is possible to press the palm of your hand upon it without cutting yourself, if you are careful not to move the hand across the blade. And this is the secret of the Hindu's trick. Though he seems to dance, he never moves his feet along the sword blades, but raises and lowers them slowly with a perfectly vertical motion.

Rowing Keeps Him Young

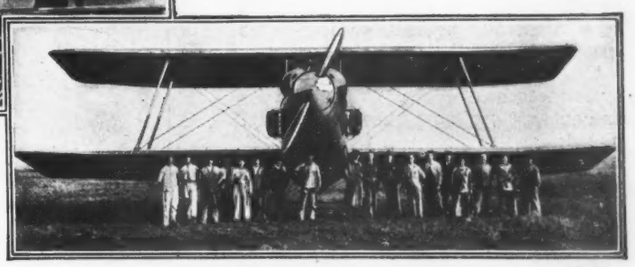
HOLD a nine foot oar in each hand, grasping them by the tips of the handles. Now, raise them slowly, keeping the arms outstretched until the blades of the oars are higher than your head. At 66, George W. Lee, of Long Island City, performs this feat to demonstrate that rowing keeps a man young.

Nearly 40 years ago Lee was the champion oarsman of the world. Since then, he has rowed steadily and coached racing crews. Now, at the age when most men think a two-mile walk is too much for them, he can step into a single-oared shell and set a pace few youngsters can equal.

The secret? Just keep in training the year round, and row daily whenever the ice is out of the river, says Lee.

Lamp Cleaner

A TRUCK tower built in two telescoping sections, supporting a revolving platform that rotates on a circular iron track, enables San Francisco lamp cleaners to work on all sides of street lamps without moving the truck. A small electric winch hoists the tower.



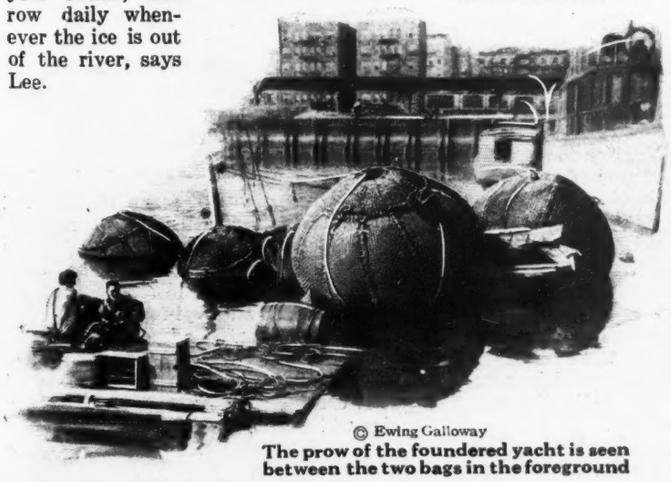
All-Metal Biplane Designed for Speed

A LARGE all-metal airplane now being demonstrated exhibits the latest features of speed design as well as the adaptation of all-metal construction to the biplane. The metal used is understood to be duralumin.

The wings are thick enough near the fuselage to permit internal bracing, becoming thin near the tips. The radiators are mounted on the sides, like luggage carriers in an automobile.

Truss forms have been adopted for the interior struts, which are only four in number. The nose cap of the plane whirls with the propeller. Contrary to familiar practice, the lower wings of this biplane are much longer than the upper.

The machine is driven by a 600-horsepower motor, and is said to be capable of 125 miles an hour.



© Ewing Galloway

The prow of the foundered yacht is seen between the two bags in the foreground

Airbags Raise Sunken Ship from Mud

SIX huge airbags or pontoons recently raised a yacht from the mud of a river after attempts to salvage the vessel by derrick had failed. The bags have rubber inner lining, walls of a double layer of heavy canvas, and are protected against shocks and abrasion by rope. Below the surface all are filled simultaneously with air through a diver's hose, and when inflated have sufficient buoyancy to pull a sunken ship from the grip of the mud and support it.

The bags were attached to slings passed under the hull through holes dug by directing a high pressure stream of water against the river bottom under the ship.

The enormous rubber balls were used also to raise from the ocean bottom the government ship *Isis*, wrecked off Florida.

New Two-Cycle Auto Engine Runs on Castor Oil

Direct Injection Design Combines Power with Fuel Economy

By Harold F. Blanchard

OPERATING on any combustible animal, vegetable, or mineral oil, a two-cycle, direct injection auto engine, recently perfected by M. Tartrais, a French engineer, has been performing so successfully as to forecast revolutionary advances in motor vehicle propulsion.

The soundness of the design is indicated by the fact that the engine is being manufactured by one of the leading French automobile makers, whose racing cars have won worldwide fame because of their speed and stamina. The first three engines made are being used on Paris motor buses.

Fuel Bills Cut in Half

Although the newcomer has no carburetor nor high tension ignition system, it develops 50 horsepower at 1200 revolutions a minute. It weighs 10 pounds to the horsepower—the same as the average standard automobile engine—and occupies the same amount of space; yet it is said to be twice as economical in fuel.

There are two vertical cylinders, in which the operation is as follows: When the piston is at top dead center, liquid fuel is injected into the combustion chamber, which is filled with pure air so hot that the fuel immediately takes fire. The high temperature of the air is due partly to the fact that the walls of the compact combustion chamber are uncooled, and partly because the air is compressed to more than 300 pounds, or four times the pressure in the ordinary engine.

The engine resembles the usual two-cycle motorboat engine in that intake and exhaust ports are uncovered by the piston; yet it differs in the fact that these ports extend all around the cylinder circumference. The exhaust openings form a ring just above the intake openings. The former are connected with the exhaust pipe and the latter with an air pump. As the piston proceeds on its down stroke after the fuel is injected and ignited, it uncovers the exhaust ports toward the end of its travel and most of the burned gases stream out through the openings. Then the piston uncovers the intake openings and pure air shoots in from all sides. Striking the conical piston head, the air streams combine to form a column of pure air that rises to the top of the cylinder head, where it spreads out and flows down the cylinder walls and thus forces out the exhaust residue.

Any combustible animal, vegetable, or mineral oil is said to be effective as fuel in the Tartrais two-stroke fuel injection engine shown here

The combustion chamber is also swept clear of gases by this action. Then the piston proceeds up on the compression stroke. As soon as its progress closes intake and exhaust ports, compression begins. When the piston reaches top dead center, another charge of fuel is injected and another explosion ensues.

There is a separate fuel pump for each cylinder and the amount of fuel it delivers may be varied by a hand or foot throttle. The air pump is located at the front and has a bore of about seven inches and a stroke of about four, whereas the cylinders of the engine are 4.7 by 5.9 inches. The air piston is double acting, supplying one cylinder on the up stroke and the other on the down stroke, a piston valve opening and closing the air ports of the pump.

The fuel pumps for the two cylinders are mounted on the crankcase and driven from the water pump shaft, while the pump plungers are cam operated.

To ignite the charge before the engine becomes warm enough to run spontaneously a little coil of wire brought to a white heat by a four-volt current is employed. The coil, placed in the combustion chamber, is mounted on the end of an insulated plug much like a spark plug.

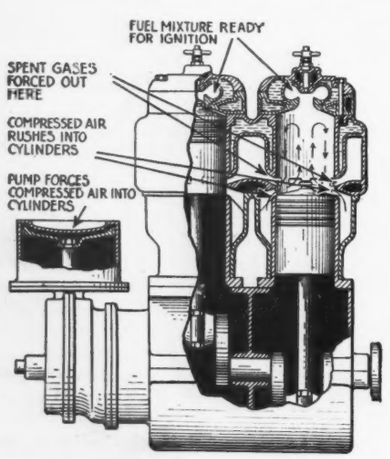
The two chief advantages of this engine are its economy and the fact that it will run on any combustible liquid. It will run at full load on less than 0.4 pounds of fuel to the horsepower an hour, whereas the best standard engines will consume about 0.6 pounds with throttle wide open. However, automobile engines are rarely run at full load, and with closed throttle the fuel consumption of the average standard engine is likely to increase to a pound of fuel an hour, whereas the new engine at one quarter load has a fuel consumption of only .484 pound.

Almost Any Oil Will Do

This means that where a standard engine will give a consumption of 20 miles a gallon, the Tartrais engine will give 40 miles—exactly twice the amount.

The Tartrais engine will operate not only on gasoline, kerosene, and alcohol, but on various crude oils and coal-tar oils, cod liver oil, sperm oil, castor oil, cottonseed oil, coconut oil, cocoa oil, and others without any change in engine adjustment.

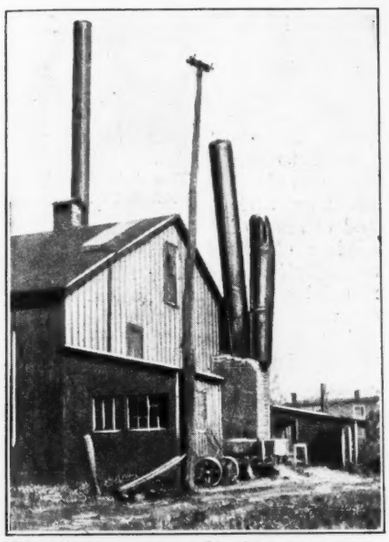
It is considered very probable that the engine will gradually come into general use for automobiles, motor trucks, farm tractors, and airplanes.


FUEL MIXTURE READY FOR IGNITION
SPENT GASES FORCED OUT HERE
COMPRESSED AIR RUSHES INTO CYLINDERS
PUMP FORCES COMPRESSED AIR INTO CYLINDERS

This diagram of the two cylinders shows how compressed air forces out exhaust residue at the bottom of the piston stroke

Iron Smokestack Turns a Somersault

HOW did an iron smokestack at Moptoursville, Pa., come to stand on its head? The stack fell unexpectedly, on a windless day, breaking in half at the point where a newer section of stack had been

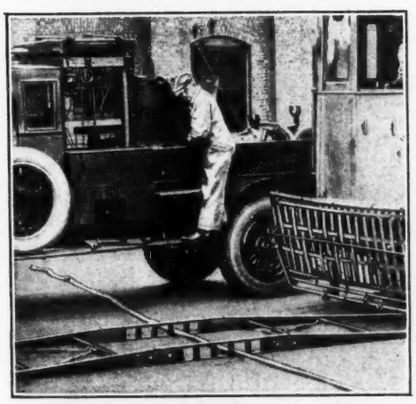


Turning a somersault, the upper portion of the stack landed upside down

bolted to the old. The break was so sudden that the upper section turned a somersault on the way down, landing outside the bottom section.

Since the stack guys were connected with the upper section, it is conjectured that at the moment the break occurred their weight acted as a force pulling directly downward, so that the top of the stack began to fall with greater velocity than the center, thus explaining the phenomenon.

Bridge Permits Cars to Pass over Fire Hose



LINES of hose laid across the tracks usually tie up street cars in large city fires; but in Los Angeles, Calif., the trouble trucks of the street car lines carry protecting bridges that fit over the rails.

These bridges are made of oak, covered with one-half inch strap iron, with openings in the center through which five lines of hose may be passed.

Beaver Fells Aspen Two Feet Thick

© U. S. Forest Service

Beavers gnawed down an entire grove of aspens. Note that all the trees are felled in the direction of the pond. One stump, shown at the right, was more than two feet in diameter

WHAT is said to be the largest tree ever felled by a beaver was recently discovered by rangers of the United States Forest Service in the Carson National Forest, New Mexico. The tree is an aspen, and the stump measures approximately 26 by 32 inches at the point where it was gnawed through by the industrious animal.

Beavers seldom fell trees so large, for they are unable to move the trunk, even after they cut it into sections. But this tree, nearly two feet in diameter, was evidently cut down for its branches. All the limbs and small twigs had been removed for food, or for building the dams and houses of the beaver colony, and only the trunk was left where it fell.

The animal exhibited the usual beaver skill in felling this giant. It was dropped squarely in the direction of the beaver pond, in order that the animals would have a shorter distance to carry the branches.

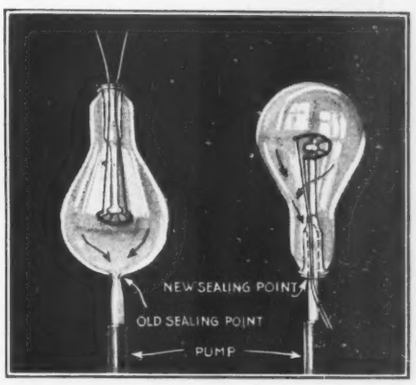
Miniature Glass Boiler Settles Disputes

UNTIL a glass model was constructed recently by A. C. Lippincott, of New York City, no one knew exactly what went on inside a return tubular boiler while it was in operation. By looking through the

Boiler action is observed through glass walls

glass walls of the ingenious mechanism, engineers can now settle disputed questions such as the path of the water circulation.

The boiler is made accurately to scale. The shell is 15 inches long and 5½ inches in diameter, with 28 tubes. Heat is produced either by a special electric heater, or by putting two blowtorches through the fire doors. The hot gases pass around the tubes and up the stack. Great difficulty was found in securing a glass that would withstand the pressures developed.



New Light Bulbs Have No Tips to Be Broken

IN the manufacture of the newest electric-light bulbs, the fragile tip is placed in a position at the base of the lamp, where it is no longer in constant danger of being knocked off.

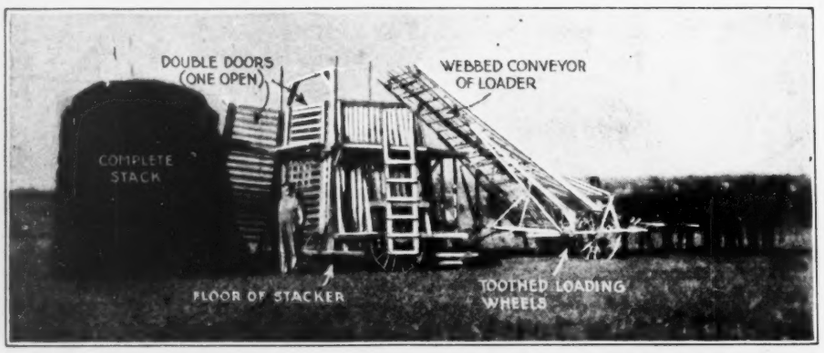
When the filaments, bracket, and supporting wires are assembled, a jet of air blows a hole through the stem through which the lamp can be exhausted. By the old method of manufacture, the globe was fused over the assembled stem and a glass tube inserted in the top of the bulb. Through this tube the air was pumped out. After the globe was exhausted, the tube was heated and pinched off, sealing the bulb, but leaving a fragile tip.

In the new method, the globe is made without a tip and fused onto the stem. The tube leading to the air pump is then fused into the hole blown in the stem while it was being assembled.

POPULAR SCIENCE MONTHLY will be glad to answer your queries about wireless. Simply mail your question, enclosing a self-addressed, stamped envelope. Make your inquiry as specific as possible.

A SAFE parachute descent has been made from the height of only 75 feet.

Harvester Rakes, Loads, and Stacks Hay



FROM swath to stack with one fifth the usual labor, is the record claimed for a hay harvesting machine invented by the Russell brothers, for use on their farms near Winfield, Kans. The machine rakes, loads and neatly stacks hay by a system that combines several operations.

The hay is taken from the ground by a toothed cylinder, and delivered to a webbed conveyor, which carries it to the top of the boxlike hay frame. This is hitched to the rear of the conveyor-loader. When the frame is full, a trip lever releases the teeth that hold the hay, and the stack slips off the floor to the ground, pushing open rear gates.

The finished stacks are 40 feet in circumference at bottom and contain from 3000 to 4000 pounds.

Felt Brush Lengthens Life of Phonograph Records

PHONOGRAPH records that have been discarded as worn out can be played again after they have been cleaned with a newly invented brush that removes the dirt from the tiny tone grooves, declares its inventor, Alfred B. Kidder, of Canton, Ohio.

The felt brush is attached to the tone arm

The instrument is attached to the tone arm of the phonograph and consists of a piece of soft felt, about an inch long and a half an inch thick, held against the record by a light steel spring. The felt is cut on a bevel, and the pressure of the spring is sufficient to force the soft material into the deepest crevices of the phonograph record's tone grooves.

Electric Light Numbers Film Negatives

LEGIBLE marking and perfect identification of the commercial photographer's negatives is claimed for a recently invented electric marker that will handle six negatives mechanically while one is being numbered with pencil or hand stylus.

The negative to be marked is placed on a felt pad that covers the flat aluminum bed of the device, and the six numbering stencils at the top are manipulated until the proper numerals appear beneath the nickel guide along the top of the pad. Then a second's pressure on an electric button flashes an electric light that is reflected through the stencil to the film. The film is then developed and the identification number appears with the photograph. The light has printed it on the unexposed margin of the film.

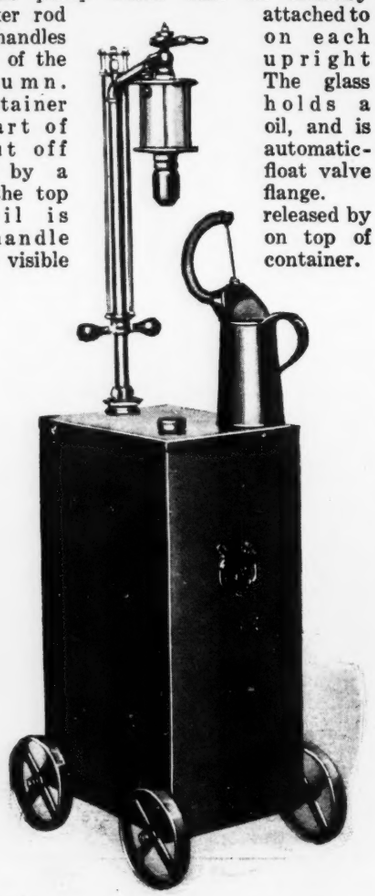
Copra Cake for Beefsteak

COPRA cake, the residue after the oil has been squeezed from the dried coconut meat, is as nourishing as beefsteak, say experts of the Rockefeller Foundation, who are trying to popularize the food among the natives of the Philippines. It is not only nourishing, but is said to prevent beriberi, common among Orientals, who live chiefly on polished rice.

Pump Now Dispenses Oil to the Motorist

OIL, like gasoline, can now be purchased from a pump dispenser that permits the motorist to see for himself that he receives full measure and clean oil. The portable tank container is designed to replace the bottles from which oil is usually dispensed at filling stations.

The pump works with an ordinary sucker rod attached to the handles on each side of the upright column. The glass container holds a quart of oil, and is shut off automatically by a float valve in the top flange. Oil is released by a handle on top of the visible container.



Oil is pumped into a one-quart glass container and dispensed by turning a handle

Watertight Model Boat Built of Old Papers

OLD newspapers were the chief material used by L. M. Spaeth, a shipyard mechanic of Pitman, N. J., in building a detailed model of a tug.

A pastepot and a pair of shears were his tools. He cut the old newspapers into strips two inches wide and laid them one on the other over a wooden model of a hull. After applying each layer of pasted strips, he dried the shell in the sun or in the oven of his stove.

When the shell was about a quarter of an inch thick, he removed the wooden form. Four wooden bulkheads were inserted to keep the paper shell rigid, and a lead keel was poured in. Four cakes of paraffin were melted and used to make the inside of the paper hull waterproof. The outside was given several coats of shellac, varnish, and paint.

The deck was made of paper and linoleum was used for the cabins. An old mailing tube provided the smokestack and a pillbox the searchlight.

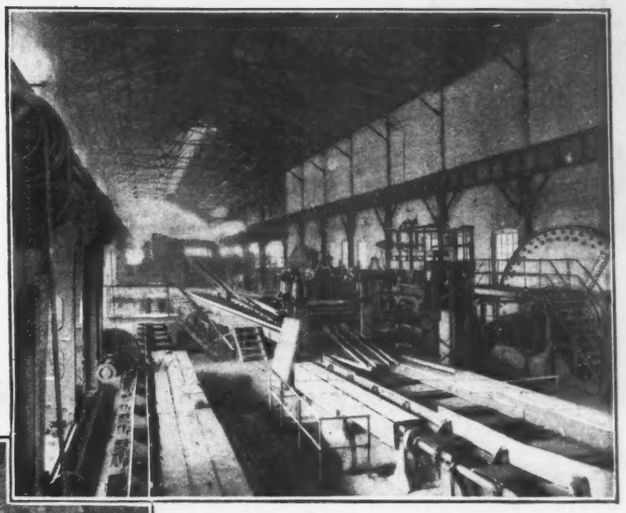
IT is estimated that over one billion gallons of gasoline are wasted annually in this country through inaccurate adjustment of carburetors.

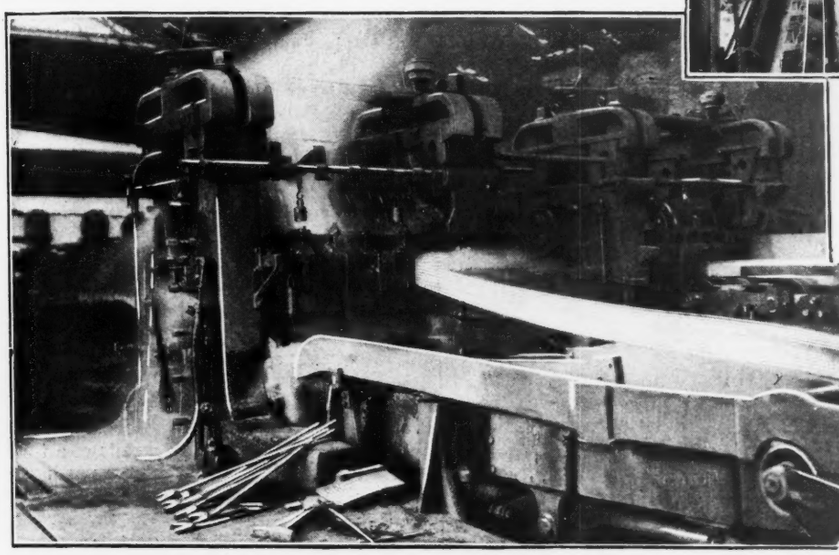
Modern Rail Mill Kneads Huge Ingots into Miles of Tempered Steel

By Ernest Welleck

NINETY-THREE years ago there were 16 miles of railroad track in America.

Today, if all the main and side tracks in the United States were joined into one continuous track, the ribbon of rails would encircle the earth more than 15 times! And in the form of a single rail, it would be equal in length to three times the distance from the earth to the moon!





At this stage in the rolling mill, the long, snakelike rail travels to circular saws that cut it into standard lengths

There, in a few words, is the romantic record of the steel rail, the conquerer of wildernesses, the builder of present-day civilization, without which our United States today would be impossible.

Less than 100 years ago the rail, born spectacularly, was the lowly pioneer, pushing inch by inch into out-of-the-way places, carrying civilization with it. In its brief, dramatic career it has brought together the remote corners of the natien, and has bound the world in a cord of steel, developing commerce, industry, and agriculture, and giving employment to millions.

In 1920, 2,500,000 tons of steel were rolled into railroad tracks in the United States alone.

The Creation of the Rail

The spectacular creation of the modern rail, from its origin in the iron mine until it is spiked and bolted into tracks, is one of white hot furnaces of bubbling molten metal, showers of sparks, and crushing, massive machinery in vast steel mills.

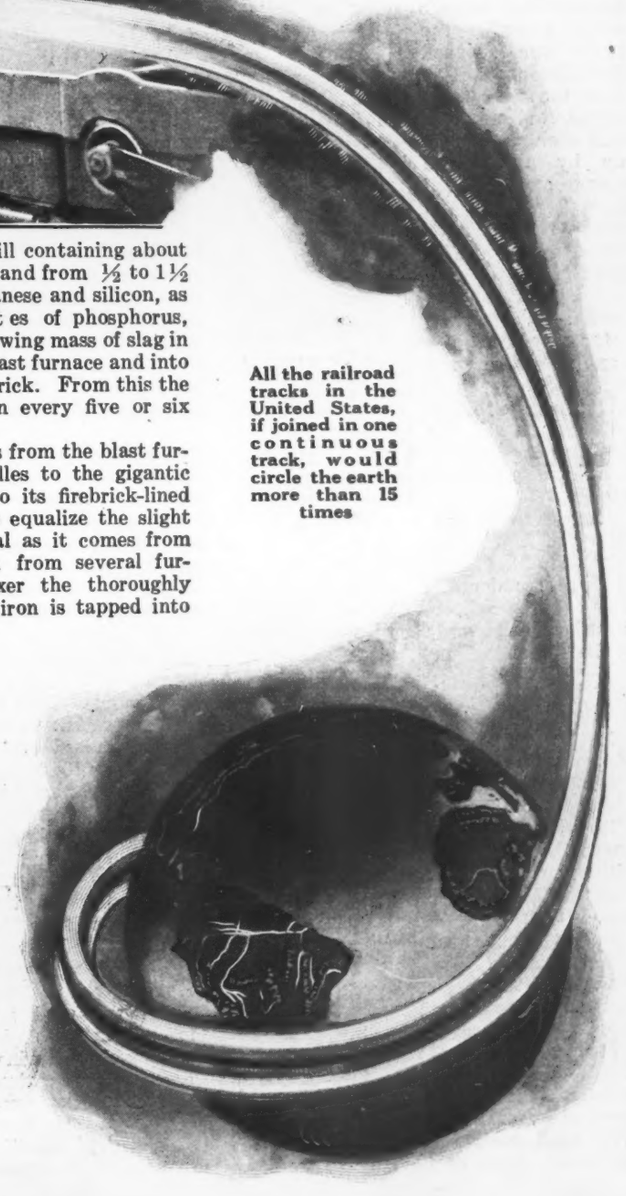
The story begins with the mining of the iron ore. This is crushed, usually at the mine, by huge machines and is then carried to the blast furnace. There the ore, which consists mainly of iron and oxygen with certain impurities, is reduced to iron and freed from its impurities.

The blast furnace is filled with alternate layers of coke, iron ore, and limestone. Then a blast of air at a temperature of from 1200 to 1400° F. is blown through this mixture. The oxygen is taken from the ore, which is fluxed by the limestone, and the carbon of the coke combines with the free oxygen and is carried off by the blast.

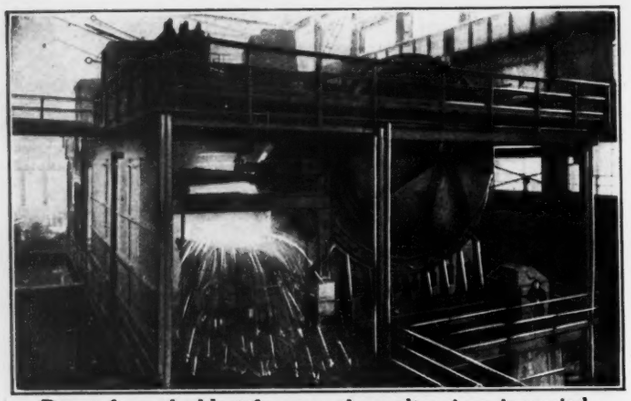
The metallic ron, still containing about four per cent of carbon and from ½ to 1½ per cent each of manganese and silicon, as well as small quantit es of phosphorus, trickles through the glowing mass of slag in the lower part of the blast furnace and into a basin lined with firebrick. From this the molten metal is drawn every five or six hours.

The iron, as it comes from the blast furnace, is carried in ladles to the gigantic mixer and poured into its firebrick-lined hold. This is done to equalize the slight variations in the metal as it comes from many heats and often from several furnaces. From the mixer the thoroughly homogeneous mass of iron is tapped into big ladles in which it is carried to the open-hearth furnace to be transformed into steel.

The open-hearth furnace is a shallow basin, 35 or 40 feet long and 15 feet wide, lined with refractory brick and provided with a dolomite floor. When the time has come to charge the furnace, a layer of scrap iron and steel mixed with limestone is dumped in the basin. Then molten iron from the mixer is poured over the scrap and limestone, until it completely covers it. Instantly a reaction begins, the lake of liquid metal commences to bubble and boil, and a scum of slag is formed on top. For a period of 10 or 12 hours the molten mixture is allowed to boil, heated by



All the railroad tracks in the United States, if joined in one continuous track, would circle the earth more than 15 times



Drawn from the blast furnace, the molten iron is carried in a ladle to a mixer. When variations in the metal have been equalized, the iron is poured again, as seen above

the flame of the gas forced into the furnace. Then the hearth is tapped and the molten metal, no longer iron, but steel, is allowed to run into a large ladle, from which it is poured into the ingot molds mounted on cars.

After the metal, from which the open-hearth process has removed the excess carbon as well as any impurities—principally silicon and phosphorus—has become solid enough, the molds are stripped from the ingots. One after the other these ingots, weighing 4½ tons each, are picked up by a powerful crane and lowered into "soaking pits," where they are allowed to remain for from 1½ to two hours. In these pits, heated with gas, the soft cores of the ingots harden, while the chilled outside parts are brought to the temperature of the cores, giving the ingots a uniform texture and the same temperature inside and on the surface.

Thoroughly mixed, the iron is carried by the monster ladle to the open hearth furnace and poured over a layer of scrap iron, steel, and limestone. Heat and chemical action turn the mixture to steel

The scene of the next chapter is the rolling mill. The tongs of a mighty crane seize one of the "soaked" ingots, lift it out of the pit and deposit it on the rolling table. The rotating rollers carry the white-hot ingot head on toward the first pair of rollers of the "blooming" mill.

Rollers Knead Glowing Ingot

With a crash, accompanied by a shower of sparks, the head of the ingot is seized by the rollers, which are driven by a 5000-horsepower engine with a 150-ton flywheel. With irresistible force the ingot is slowly forced through the rollers and back again with reversed engine after having received a quarter turn before each pass. By this process the thickness of the metal is diminished, its length correspondingly increased, while its texture is improved by the kneading between the rollers. During this operation the rollers are constantly cooled by a shower of cold water.

From the first set of rollers the white-hot block of steel, which is now called a "bloom," is passed on to another mill with three rolls, each 40 inches in diameter. With each passing through these rollers the bloom grows thinner and longer until it is reduced to standard size for the rail or finishing mill. Next, it is carried to the blooming shears, which snip off all spongy or otherwise defective metal and cut the piece in halves.

From the blooming mill the bloom travels to the reheating furnace, where it is brought to the proper temperature for the rail mill — between 1200 and 1400° F. Then the bloom starts on its journey through many sets of rollers, which gradually, with much pressing and turning, work it into the form of a rail.

From the last finishing "pass," the long, snakelike and still white-hot rail travels to the hot saws and is sawed into rails of standard length, 33 feet each, with from 6½ to seven inches allowed for shrinkage. From the saws the rails go to the cambering rolls for preliminary straightening, thence to the cooling beds, where they are laid on their sides to cool.

After the rails have become sufficiently cool, they are carried to the powerful straightening presses, after which the bolt holes are drilled and finished and the rails are given a final inspection. Each rail is stamped with the date, the letters or numerals indicating the nature of the steel, the heat, blow, or melt, and even the part of the ingot from which the steel of the rail was taken. Modern standard rails weigh from 130 to 140 pounds a yard and in exceptional cases even more. It is believed that before long it will be found expedient to increase the weight of rails to 200 pounds a yard.

The first rails were made of iron in 1767 and were used for track purposes in an English coal mine. Before that time wooden tracks were employed; these, however, proved unsatisfactory when wheels of cast iron were substituted for the wooden wheels originally used on mine trucks. In 1767 the Coalbrookdale iron works cast a quantity of iron rails or plates, each three feet long and four inches broad, with an upright flange at the inner side, to keep the wheels from running off the track. About 1820 the length of the rails was increased to 18 feet and their weight varied between 28 and 36 pounds a yard, according to the thickness of the rails.

The evolution of the rail was not confined to a gradual increase in length and weight. Constant efforts were made to improve the form of the rails and more than 100 different forms were evolved and subjected to practical tests in actual use.

The First American Railroad

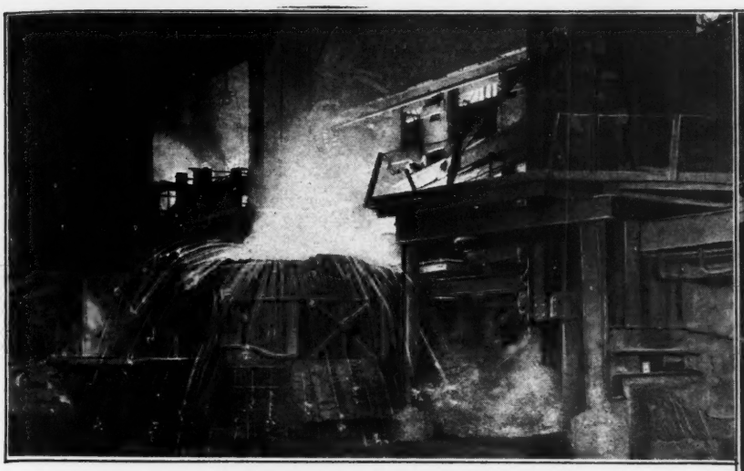
The invention of the steam locomotive at the beginning of the nineteenth century and the rapid development of railroads gave a tremendous impetus to the demand for track rails. The first American railroad was built from Carbondale to Honesdale, Pa., a distance of 16 miles, and the first successful run of a train was made on August 9, 1829. In the following year the total trackage in the United States reached 32 miles—a total length of rail of 64 miles.

Up to 1867 only wrought-iron rails were used on American railways. At that time the Bessemer process of making steel by blowing air through molten cast iron contained in a pear-shaped converter was introduced and henceforth rails made of Bessemer steel began to gain in favor. In 1880, the Bessemer rail overtook the wrought-iron rail, and steel rails of a total weight of 852,000 long tons were produced, almost double the tonnage of wrought-iron rails manufactured in the same year. From that time on the use of wrought-iron rails was gradually abandoned except for narrow-gage mine and quarry tracks.

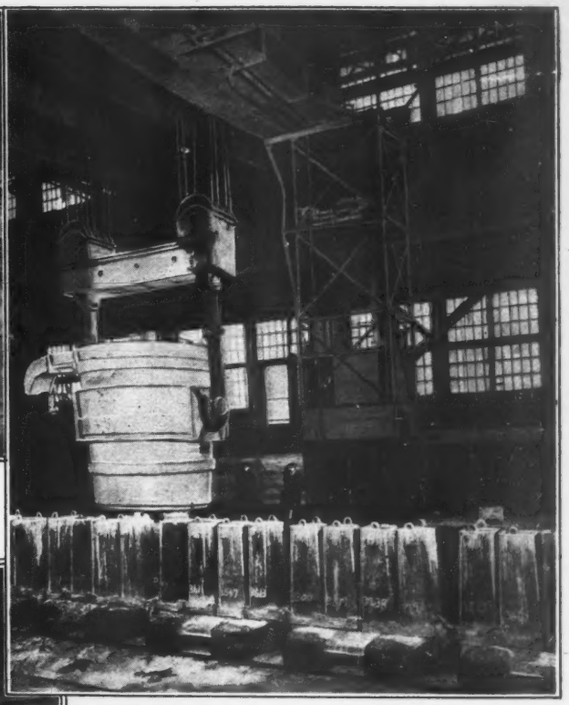
Open-Hearth Process Successful

The next milestone was reached when the open-hearth process of making steel was invented. In 1895 only 700 tons of rails were made of open-hearth steel. But, from year to year the tonnage of these rails increased. In 1910 the tonnage was 1,751,000, compared with 1,884,000 tons of Bessemer rails; but two years later 2,105,000 tons of open-hearth steel were rolled into rails against 1,100,000 tons of Bessemer steel. In 1920 the steel works of the United States produced a total of more than 42,000,000 tons of steel, of which more than 2,500,000 tons were rolled into rails. Since 1900 the railroads of the United States have annually added, in the average, 4500 miles to their mileage, or 9000 miles of rails.

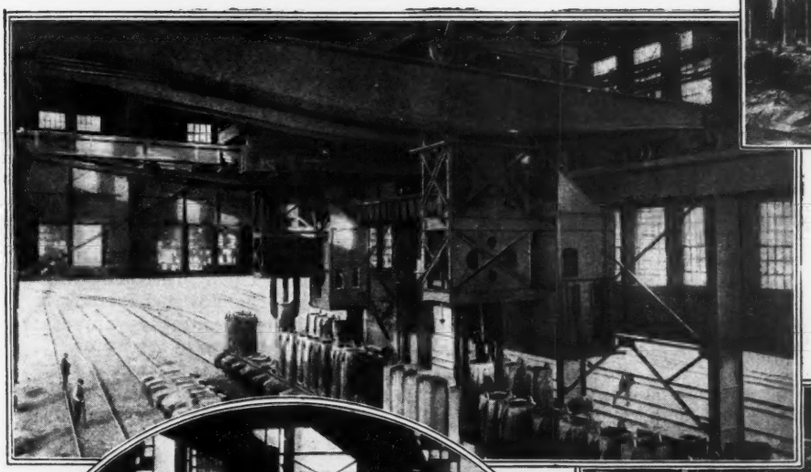
From the cars shown at the left, steel and scrap iron are dumped into the open hearth furnace, a shallow basin 40 feet long and 15 feet wide



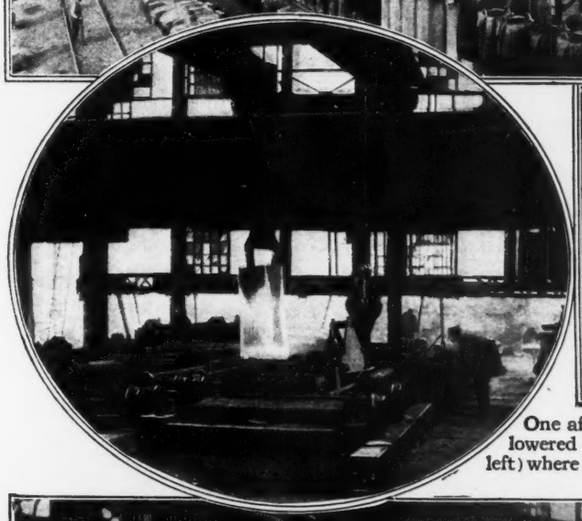
Tapping the open hearth furnace is like a display of fireworks. A river of steel is set free and, splashing sprays of fire, pours into a gigantic bucket



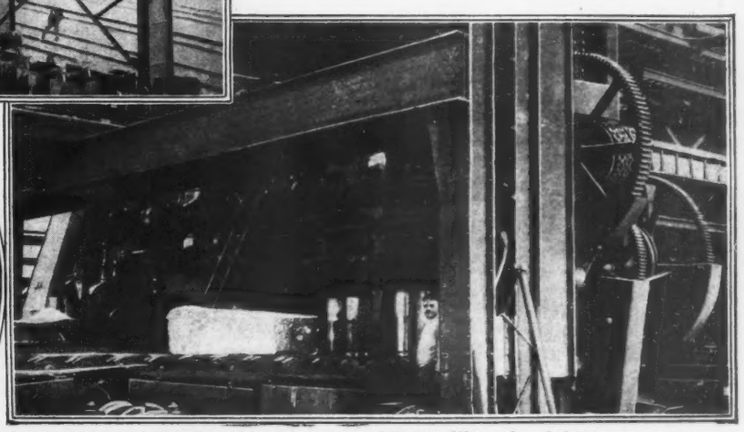
Picked up by a carrier suspended from a ceiling track, the bucket passes from the furnace and pours its contents into ingot molds mounted on small cars



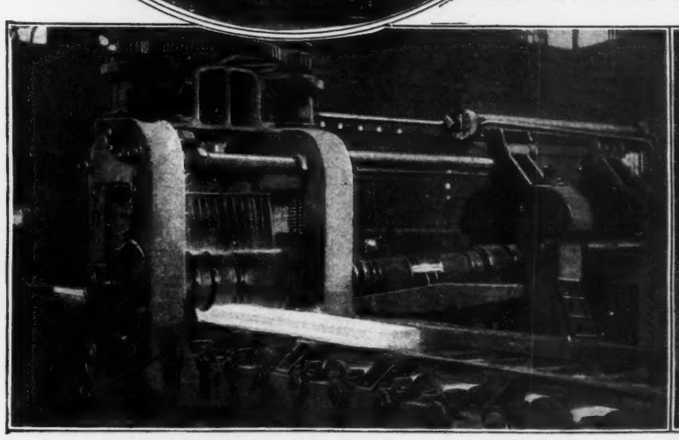
When the white hot steel becomes solid enough, the molds are stripped from the ingots, as shown at left, and the ingots are raised by a powerful crane



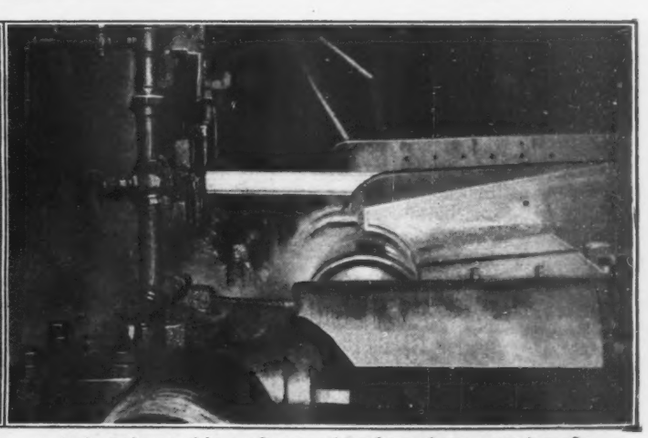
One after another, the 4½-ton ingots are lowered by the crane into "soaking pits" (at left) where the solid ingots are uniformly heated



"Soaked" to the right temperature and consistency, the ingot now enters the rolling mill

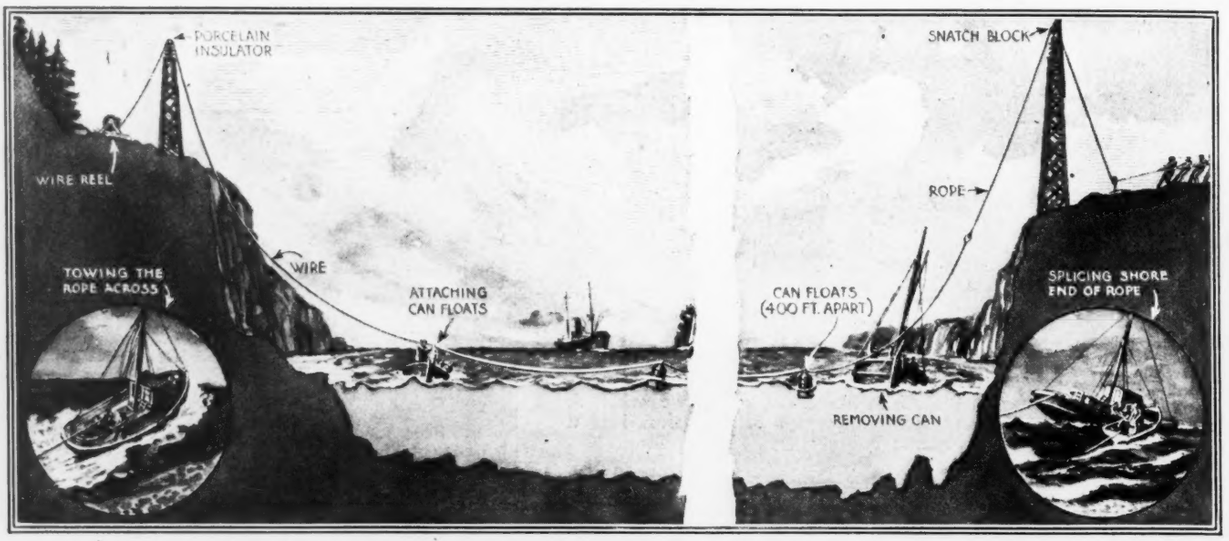


Rollers driven by a 5000-horsepower engine seize the head of the heavy ingot and with irresistible force knead it back and forth into a long narrow bar



At last the steel bar, after passing through a succession of rollers that gradually work it into shape, emerges in the form of a rail, to be sawed into the correct lengths

Held Afloat by Cans, Wire Is Strung across Rough Waters



Successive steps in stringing a span wire across three fourths of a mile of water from Tatoosh Island to Cape Flattery, Wash., without allowing a wire to touch bottom, are described in the picture above. Empty oil cans, placed at 400-foot intervals, served as floats

ACROSS three quarters of a mile of storm-tossed water, swept by strong tidal currents, between towers on Tatoosh Island and Cape Flattery, Wash., engineers recently strung an overhead telegraph wire from shore to shore, without permitting it to touch the bottom of the channel.

Empty five-gallon oilcans turned the trick in the following manner:

The span wire was wound on a reel on shore at the foot of the mainland tower. A brake on the reel prevented the wire from over-running, and an eye was spliced in the end of the wire.

When everything was in readiness a power boat ran close to land and threw ashore the end of a manila rope. After this was fastened into the eye of the span wire, the boat headed full speed for the opposite shore, paying out the rope as it went, but keeping a fair strain upon it. On the shore the brake on the reel was set, and no wire allowed to run out.

When the boat reached the island, the rope was run through a snatchblock at the top of a second tower, and passed to a gang of eight men, who hauled away.

As the wire began to run out from the reel on the mainland, men in a small boat anchored 30 feet from shore fastened an empty five-gallon can to the eye-splice. Other cans were fastened to the wire at intervals of about 400 feet.

Working rapidly, the linemen continued this method until the eye splice passed through the snatchblock on the island tower. The island end of the span was then spliced in place, and the span lifted with the usual lineman's "come-along," while the power boat cut the empty cans free from the wire as it slowly left the surface of the water.

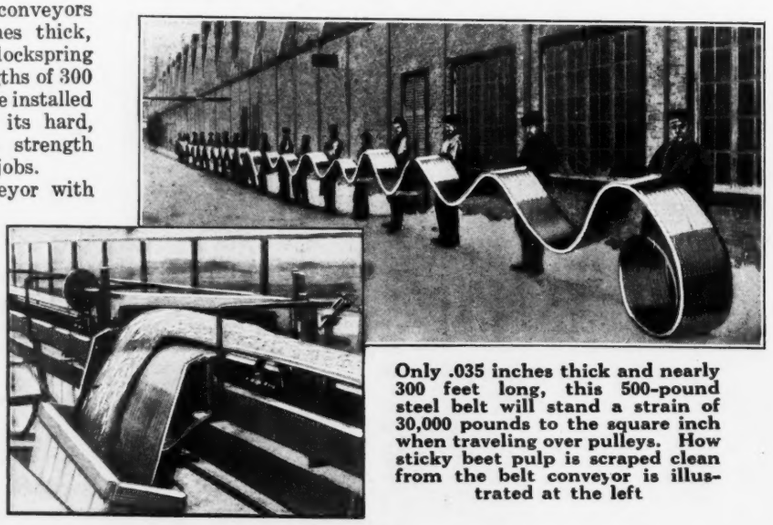
After it was strung, the wire successfully withstood a 110-mile gale. Another wire slipped off one of the towers and tons of floating kelp caught in it while it was hanging in the water. When this kelp was cut off, it was found the wire had stretched nearly 17 feet. It is still in commission.

Thin Ribbon of Steel, 300 Feet Long, Is Durable Belt Conveyor

THE latest development in conveyors is a steel belt, .035 inches thick, which looks like a gigantic clockspring and is sometimes made in lengths of 300 feet. It is flexible enough to be installed in the usual manner, while its hard, smooth surface and tensile strength adapt it to difficult conveyor jobs.

When installed as a conveyor with standard size pulleys the belt is subjected to a strain of 30,000 pounds to the square inch when traveling over the pulleys. In service it is flat and rigid. In a short time its surface acquires such a polish that friction is said to be almost negligible. Steel belts used in the open air in the sugar, pulp and lumber industries of Sweden have not been damaged by rust, for while a thin rust film forms on the surface, it does not penetrate, but protects the steel from further injury.

As compared with a flat rubber belt of the same width, the steel belt, it is claimed, possesses greater transverse rigidity and larger carrying capacity, since the edges, even with a one-sided load, will not sag downward. This allows a larger area of the belt to be loaded.



Only .035 inches thick and nearly 300 feet long, this 500-pound steel belt will stand a strain of 30,000 pounds to the square inch when traveling over pulleys. How sticky beet pulp is scraped clean from the belt conveyor is illustrated at the left

Steel belts are said to have materially widened the field of the belt conveyor, since they are particularly adapted for hot, sticky, and abrasive materials. Material as sticky as hot sugar can be scraped off easily, it is claimed, while sharp cutting agents, like broken or powdered glass, can be conveyed without damaging the belt. Similarly, material too hot to be handled on ordinary belts will not injure one of these ribbons of steel.

Other advantages over apron conveyors and wire woven belts, it is claimed, are reduction of power consumption and elimination of spilling materials through joints and interstices.

The new belt is made of a flexible steel which is cold rolled, hardened, and tempered by a special process. It is designed in two ways—either with the conveying strand sliding on a wooden support like a trough and the return strand supported on idlers, or with both strands carried on rollers in the usual fashion. The sliding type, with or without skirting boards, is used especially in sawmills and wood-pulp mills, for carrying boards, logs, chips, sawdust, and charcoal. The resistance of the belt to rust and to chemical action has made it particularly useful in the fertilizer industry, in which it has been adopted extensively abroad.

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Fishermen Catch Monster

Why the octopus is dreaded by bathers in the tropics. A rare specimen, shown at the left, which recently fell into the hands of New England fishermen. This monster devilfish has eight prehensile tentacles, each with double rows of suckers, and a large, horny beak like a parrot's, with which it tears the prey held fast in the tentacles. A most unusual characteristic is a thin, umbrellalike membrane or web connecting the long, snakelike arms

He'll Ride on His Back

Dragged by an auto flat on his back, from New York to Chicago, without stopping for the worst bumps or the roughest road, Hale Ruth of the former city expects to complete the 1000-mile journey uninjured. He will be protected only by a football helmet and six thicknesses of leather. No skids will protect his body from the road. Tow ropes will be attached to a short crossbar under his heels

Dutch Cheeses Roll Aboard

Loading Dutch cheeses is like rolling balls in a bowling alley. Thanks to the fact that true Holland cheeses are as round, and nearly as hard, as cannon balls, they are loaded into barges by a simple gravity chute as shown below. This chute is the great-granddaddy of modern loading devices. Pivoting on a simple wooden horse, it bears an interesting resemblance to the great spout loaders seen on American waterfronts

© Keystone

Golf Has Its William Tell

William Tell's latest rival is Bob Morrison, of Los Angeles, champion "trick golfer" of California, who uses a man's nose as a tee. Harry McNamara acts as the target

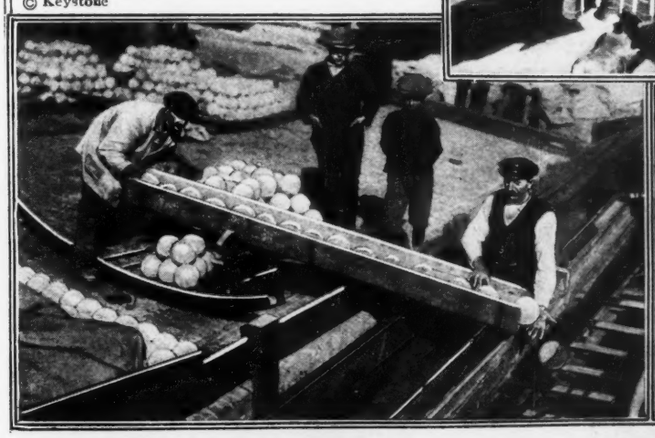
© Ewing Galloway

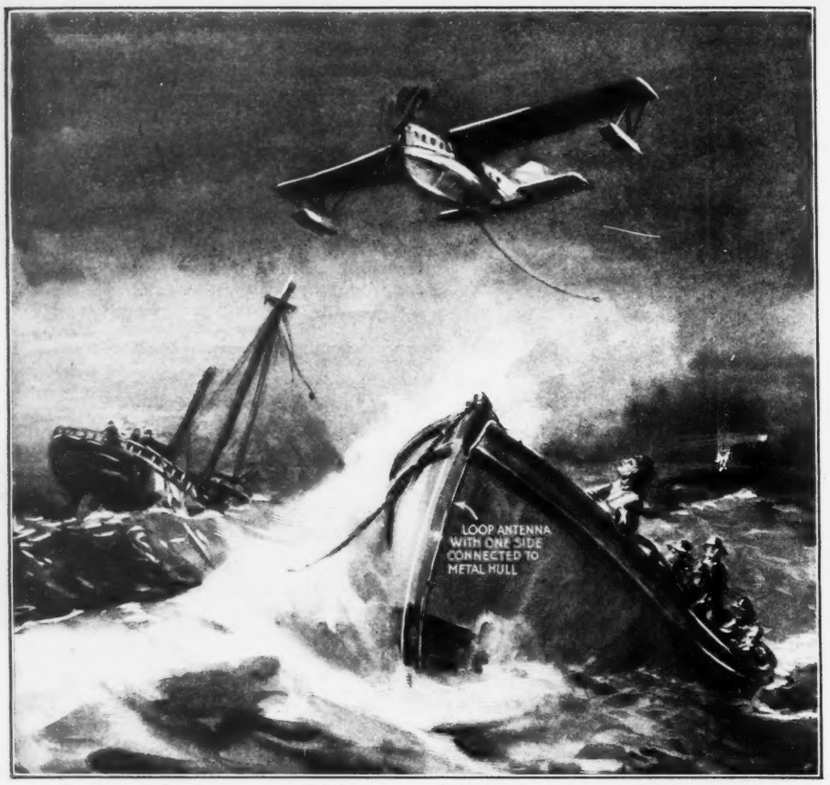
Egyptian Still Is Kickless

The Egyptian still pictured at the left is used to purify waters of the Nile for drinking. To the water tank, carried by the vendor on the streets of Cairo, is attached a crude distilling apparatus

Turn Off the Power First

If a car catches fire, and there is a charged overhead wire, DON'T try to quench the blaze with water, as shown below, or you will invite disaster; for water is an excellent conductor of electricity





In the teeth of a storm, a lifeboat crew, fighting its way to a sinking vessel, is guided from air and shore by radio telephone

Radio Guides Lifesavers in Storm

STUNG by blinding spray and buffeted by heavy seas as they fight their way desperately to the aid of a wrecked vessel, lifesavers along our coasts will now have a powerful assistant in the form of the radio telephone.

When the crew of a lifeboat, in the midst of a howling gale, are unable to see the wrecked ship toward which they are trying to steer, or to formulate a plan of rescue, observers on the shore or in the air can transmit information to them by wireless.

Radio telephones are soon to be installed on Uncle Sam's new coast-guard cutters, it is said, as a result of practical tests recently conducted at Atlantic City, N. J., which demonstrated that a radio-telephone set can be carried in a 36-foot motor-driven self-bailing lifeboat and can send and receive within a radius of five miles. The action of the boat on the waves has no effect on the radio wave length nor on the audibility of the signals.

While an ordinary aerial can be used at the shore station, the boat requires special equipment. Loose wires or antennae are impossible on a lifeboat, since they would interfere with throwing lifelines and would prevent the boat from righting itself after an upset. Hence, coil loops, similar to those used by submarines for radio communication, were adopted for sending and receiving. The metal keel of the lifeboat forms part of the radio-telephone loop.

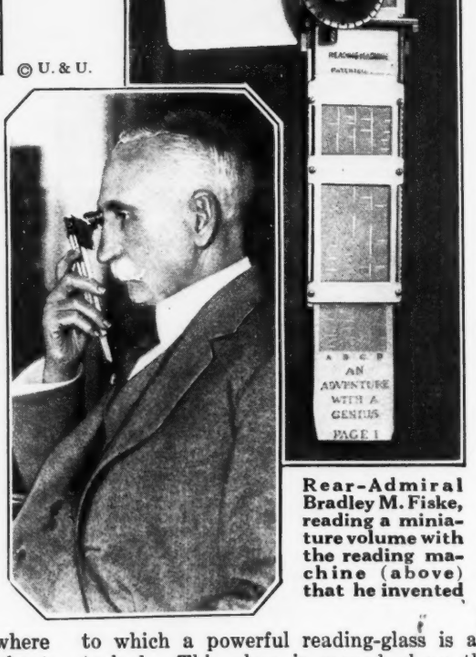
The tests disclosed that the strength of the messages received on a lifeboat varied according to whether the boat was moving toward or away from the shore. As is usual in loop sets, there were two "areas of extinction," or places where no signals could be heard, when the boat turned in a circle. These areas, however, covered only about 10 degrees of arc when the boat was far from land, and were not extensive enough to prohibit practical use.

Admiral Fiske Invents Pocket Bookcase

YOU can carry a 20-volume encyclopedia in your coat pocket if it is printed on the tabloid reading machine recently invented by Rear-Admiral Bradley M. Fiske, U. S. N., retired, and author of a recent book on invention. Admiral Fiske, turning his genius to the field of printing, has produced a machine that he believes will reduce the cost of a book to about one sixtieth of its present value.

Typesetting, bookbinding, and the rest of the customary processes are eliminated entirely. The typewritten pages of a book are reduced by photo-engraving to one hundredth their original size and printed on strips of paper two inches wide and five inches long. Printed on both sides, five such strips contain the reading matter of an entire novel. Admiral Fiske estimates that 10,000 copies of a 100,000-word book can be produced in this way for four cents a copy.

The microscopic print is read by placing the strips in a light aluminum frame, about six inches long and weighing less than five ounces,



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Rear-Admiral Bradley M. Fiske, reading a miniature volume with the reading machine (above) that he invented

to which a powerful reading-glass is attached. This glass is moved along the printed strips by the reader's finger. The glass magnifies the characters until they become as large and easy to read as ordinary print. A roller on the frame brings the reading matter into focus.

With this invention in general use, books and periodicals could be distributed broadcast by airplane, and it would be possible for engineers and scientists to carry complete works of reference into the field. Enough reading matter might be sent in a letter, for two cents postage, to last a prospector for six months. A person who likes books, but who must move so often he cannot collect them, might carry a 50 or 100 volume library in a cigar box.

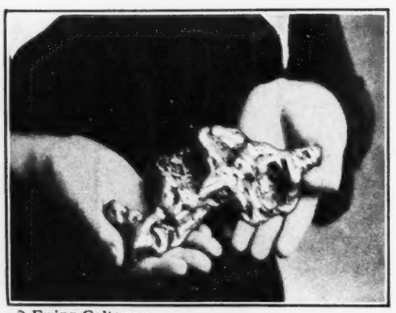
Admiral Fiske, still full of enthusiasm for scientific discovery, is the inventor of the Fiske range-finder for use on big guns, which has been adopted by the navies of the world.

His newest invention is the outgrowth of the admiral's efforts to create an easy way of reading without too great a strain on the eyes.

Five Pounds of Gold in California Nugget

THE largest nugget ever found in the United States, containing five pounds of pure gold, was the bonanza discovered recently in Plumas County, Calif., by Joe Baccala and Billy Roedde, two elderly prospectors who have worked placer mines in the West for many years. The assay value of the gold is only $1648, but it is priced at more than five times that sum because of its record size.

The story is that the finders wept for joy when they discovered it and refused to sell it until the streak of pay dirt in their claim pinched out and compelled them to do so. Larger nuggets have been found in the Ballarat Fields of Australia. The world's record nugget weighed nearly 20 pounds.



© Ewing Galloway

Five pounds of pure gold are contained in this California nugget, the largest ever found in the United States

Are Little Hidden Glands Our Masters?

Through Mysterious Chemical Laboratories in Human System Scientists May Find a Way to Remodel Our Personalities

By John Walker Harrington

NOW that the transmutation of elements has been achieved, is the transmutation of human beings next on the program? Is science on the point of discovering a way to make over your entire personality at will?

The latest scientific fad—one that is already succeeding the vogue of vitamines and psychoanalysis in universal interest—would seem to answer "yes" to these questions. If the effect on our bodies and souls of certain mysterious little glands tucked away in various corners of the human system is as sweeping as some scientists now assert, it would seem that some day we may be able to go to a "soul chemist," learned in the delicate secrets of gland secretions, to obtain, according to our own specifications, an extra inch or two in height, more hair, brighter eyes, magnetic charm, or whatever particular variety of person or personality we want to become.

For, in fact, it is *personality* itself—the complex, mysterious quality that makes us different from each other, and by which alone we succeed or fail in life—that some scientists believe to be explained, at last, by the new knowledge of the "ductless glands" that regulate our systems.

The claims of biologists who espouse the new gland theory in its most far-reaching aspects are indeed so amazing that they may turn topsy-turvy most of the standards by which we judge or doctor our fellow beings. Those who follow the path of the gland enthusiasts must do so over the shattered ramparts of much accepted psychology, medicine, philosophy, and ethics.

The fuse that has set off the latest explosion of popular interest in this biological subject, with its vocabulary of "hormones," "endocrine secretions," "pituitocentric personality," etc., is a book, "The Glands Regulating Personality" (*Macmillan*), by Dr. Louis Berman, physician and biological chemist at Columbia University. Many readers finish Doctor Berman's book quite convinced that certain tiny chemical laboratories in their bodies, such as the thyroid gland in the throat, are between them a sort of soviet dictatorship of the human system, making us what we are down to the last bit of nerve and muscle. From the length and curve of our eyelashes to the innermost quirks of mind or soul, we are, according to this theory, creatures of our own ductless glands.

Whether or not the majority of us are ready to acknowledge the sovereignty of these busy, automatic manufacturing chemists over our entire lives—whether or not we are ready to cede to them the mastery of our souls—we are bound to be fascinated by the new scientific discoveries that show us to be certainly, in some degree, under their invisible rule.

Stationed at various parts of the body—in the neck, at the top of the kidneys, in the skull—these small groups of cells are constantly manufacturing certain chemical solutions and sending them through the blood stream to the parts of the body that need them. Some of the glands have their own pipe lines, or ducts, that dispatch their products; others cause their output to seep through the walls of the structure in which they are made. The latter are known as ductless, or internal secretion glands.

The ductless glands for centuries have baffled physicians, but we now know that the fluids they produce tend to speed up our various bodily functions. Their active principles have therefore been named hormones, from the Greek words meaning something that sets other things in motion.

The arch conspirator of the gland system is the thyroid, which is just over the windpipe and quite near the larynx. It is really two organs, connected with a narrow strip of tissue. The thyroid is supposed to be a relic of the earliest stages in the development of the human race. Those who hold to the Darwinian theory declare that life originated from chemical action, probably in the sea, and that out of jelly-

Phantoms of People Your Glands Might Have Made You

THE ghost of every one of the personalities pictured above, not to mention hundreds of others, lurks hidden in your body from birth, ready to seize upon you and make you over into a genius or a giant, or a dwarf in body or a child in mind—in fact, to change your whole life.

This is one meaning of the new theory of glandular influence on our bodies and souls. If the theory is correct, then the character which you actually resemble among the ghostly group of persons-you-might-have-been depends on the mere chance of the glandular balance of your system, and the particular group of chemical secretions that finally get control of you

Has Fate Been Tracked to Its Lair in Your Own Body?

SCIENCE and history contain more real romance to the chapter than a whole year's output of popular fiction. And one reason that history, frequently retold, yet remains fresh and fascinating, is that science continually comes to bat with new discoveries that necessitate the retelling of the history of human achievements in completely revised terms.

For instance, we may soon see history interpreted for us all over again in terms of ductless glands and internal secretions. Any arch villain, from the Roman emperor Nero to the ex-Kaiser of Germany, may be explained not as a consciously responsible criminal, but as the victim of tiny, chemical-producing cell groups in his own system which determine his temperament and acts. The whole history of a nation may be traced to the blindly officious activity of hidden centers of chemical production in the bodies not only of its leaders but of its citizens.

Without being swept off their feet by the new theory of glandular control of personality, outlined on these pages, many readers may feel, at least, that it has taken them another step or two ahead on the road to understanding of the great mysteries of life and fate that we are forever seeking to solve.—*The Editor.*

Famous Surgeon Tells How Glands Renewed His Youth

HOW those mysterious chemicals known as hormones, secreted by our ductless glands, rule the entire human system has recently had a remarkable public demonstration in New York.

When the national commotion aroused by the arrival in America of Dr. Adolph Lorenz, world-famous bloodless surgeon of Vienna, had subsided, his host of patients were utterly astounded at the way this 68-year-old Samaritan worked like a dynamo, night and day, treating hundreds of crippled children with powerful muscular skill, and literally exhausting his younger associates by the pace he set for them.

Calling a Halt on Old Age

"How can a man of his age do it?" people asked.

Then the secret came out. Doctor Lorenz, before sailing for this country, had undergone the now famous Steinach operation, by which the inroads of old age are said to be checked. This glowing, tireless, white haired miracle worker among crippled children, with his youthful, resilient physique, is apparently a notable living example of the influence of hormones in making over a man's body and spirit.

When the gland theory was still in its infancy, Dr. A. A. Berthold, of the University of Göttingen, in Germany, found that certain glands of roosters, when removed and transplanted under the skin, still gave out a secretion of such potency that the vigor of the fowls was not affected in any way. Hence the great principle was established, as far back as 1849, that these glands had two secretions, one of which was a hormone derived from the interstitial glands.

This discovery is used by Dr. Eugen Steinach, of Vienna, in the operation which, so far, is said to have helped many authors, actors, musicians, journalists, and financiers to regain their grip on life. The promise is held out that in advancing age laborers, mechanics, clerks, farmers—everybody, in fact—may find in hospital or clinic the chance to recover the strength of earlier years for the tasks of life. Dr. Adolph Lorenz, as the most famous monument to the value of this operation, consented recently to waive medical formalism and grant *Popular Science Monthly* an interview concerning it.

"There is no mystery about it at all," declared the Austrian surgeon. "Three weeks after I had submitted to the Steinach operation, in April of 1921, I felt the years dropping from me and the strength of my younger days returning.

"The operation itself is a very simple one. It consists in cutting a small white cord, or vessel, known as the vas deferens This is done by binding it at two points a short distance apart, and cutting the section thus separated. The effect is to stop the flow of a fluid containing both the cells that reproduce life and those mysterious bodies known as hormones. As their outlet no longer exists, the tissues secreting the life cells disappear, but the production of the hormones is greatly augmented. The hormones are then sent out into the blood stream like the hormones from other ductless glands, and they begin at once to invigorate the whole system.

Steinach Operation Limited

"Often as a result of this general toning up of the system, deafness due to old age is removed, the sight may be strengthened, and, in fact, the whole body may undergo regeneration. Of course, successful results cannot be obtained in every case, but as the operation is very simple, and can be performed with safety by any good surgeon observing all the antiseptic precautions of modern science, the risk is really nothing.

"Complete rejuvenation," Dr. Lorenz added, "is not the portion of those who are Steinach patients. For the medical profession to hold out hope of Ponce de Leon's search for eternal youth would be sheer folly. There is a certain restitution of the powers of youth, but we do not get back anywhere near our teens. There have not been enough cases yet for us to even predict the effect of the operation upon longevity. But it will undoubtedly enable us to live more usefully up to the very end."

Operating six hours a day, Dr. Adolph Lorenz, in three months, treated 2203 patients at the New York City Free Clinic and performed more than 100 operations. Each day he worked three hours at a stretch without rest, examining a new patient every 10 minutes; yet at the end of the day he was still fresh, while his younger assistants were exhausted. The power of Dr. Lorenz' hands, which have made him world famous as a bloodless surgeon, may be observed above

like masses finally came a fishlike being, which escaped from the salt water, went through various changes, and became the ancestor of the human race. In the thyroid gland there is still manufactured a great deal of iodine, which is considered to be a substitute for all the iodine that the sea creature had to have when he made his home in the waves. To this day, it is possible to change some varieties of water lizards, or newts, into land lizards, or salamanders, by feeding them a little thyroid extract. Often human beings who live on the shores of fresh water lakes are deficient in the iodine, and develop that swelling about the thyroid gland known as goiter.

Thyroid Secretions Give You "Pep"

The lack of thyroid secretions means a dearth of "pep." The thyroid gland is where the punch comes from. When it is working full time, we are self confident, on our toes with vibrant energy, and are ready to do our utmost. The thyroid would help us summon our powers until the whole wide universe is ours. "Without the thyroid," writes Doctor Berman, "there can be no complexity of thought, no learning, no education." It is the energizer of the system, and yet at times it may speed things up too much and rack the human machinery to pieces, if it gets beyond control.

Another important factor in keeping up the tone of the body is the pituitary gland, which is in a bony cradle in the base of the brain known as the "Turkish saddle." This gland has a little coffer or skull of its own, which so protects it that it is one of the most difficult organs of the body for the surgeon to reach. It looks like a grayish yellow pea, and, in fact, is not much to look at, at all. Among its duties is the regulation of the amount of salt in the blood. Here we hark back again to the ocean origin of man, for the blood is much like sea water, and, indeed, a salt solution is often used to take the place of heavy losses of this vital fluid.

This gland regulates our growth and height, its activity or failure being held largely responsible for the giants and dwarfs of circus side shows, and for variations in size between more normal persons. When the pituitary gland is cut out, the action of the body slows down and we become cold-blooded and listless. Both the thyroid and the pituitary gland control growth, but the first affects the tissues, the second the bones.

You know certain men who are always ready to fling themselves into a slugging match, even before the chip is knocked off their shoulders. We have had a Roosevelt whose hat was always in the ring. The quality that makes some men always ready for a fight or a frolic is due to the "glands of combat," the adrenals, which are so called because they are perched on top of the renal organs, or kidneys. Once thought to be merely little lumps of fat, they were later found to take a very important part in the play of life forces. The active principle, or hormone, of this gland, is adrenalin. It is thrown into your blood in a steady stream, when the sensation of fear comes. Nature thus makes an effort to flood your body with the chemical basis of courage. The coward, then, may be merely a person deficient in a reserve stock of this valuable substance of which valor is made.

Why Some Women Are Mannish

When the adrenals fail to function, we have the nervous breakdowns, the prostrations, those attacks of polite neurasthenia that require ocean trips and Atlantic City in the summer, and Palm Beach when chill winds blow in the north. Women who have too much of the adrenal secretion become masculine and self-assertive, take to wearing mannish clothes and monocles, and become captains of industry. The adrenals, then, are very marked examples of how the mysteriously working glands are supposed to determine for you blindly, regardless of your wishes, just what sort of person you will be.

One of the least understood of the glands is the thymus, which is in the chest, over the windpipe and not far from the region of the heart. It looks not unlike a reddish

brown sponge, when cut. The indications are that the thymus has something to do with the development of the muscles, and with the maintenance of the general tone of the body. In infancy, it serves to keep the intellect from budding too rapidly, and maintains the charming traits of childhood. An infant prodigy, in whom parents take such pride, is, according to this view, merely a young person whose thymus has lost its brake.

"Ghost of the Third Eye"

Abnormally brainy youngsters may trace their powers to the activity of another gland also—the pineal. Prehistoric forerunners of the human race are supposed by science to have had an eye in the back of the head. This little lens to leeward has become, now, the pineal gland, situated in a bony socket under the pituitary gland. It contains pigment similar to that which colors our eyes to-day. Once the pineal gland was hailed as the very seat of the soul, but the theory that gave it that designation has long since been thrown into the discard. This "ghost of the third eye," as Doctor Berman calls it, is one of the regulators of growth. When it is diseased, in children, the unfortunate sufferers are likely to loom up abnormally, as was the case with a certain German boy of five years of age who in a few weeks could hold his own among boys of 14 or 15, and showed strange signs of precocity.

The parathyroids are four tiny glands, no bigger than mustard seeds, which are really thrust into the substance of the thyroid itself. They serve as dampers to keep the nerves from becoming overstrung, and they also regulate the amount of lime assimilated by the system.

Just as these small organs are responsible for keeping the lime from getting out of the storehouse of the system before it can go into bone making, so another important gland, the pancreas or sweetbread, attends to retaining the sugar supply. The sugar is drawn from the liver into the blood, the adrenals acting as pacemakers, while the pancreas does the handicapping. A common disease due to troubles of the pancreas is diabetes, the result of the release of too much sugar into the system.

To sum up, in the Council of the Glands there sit eight important members—the thyroid, the pituitary, the adrenals, the pineal, the interstitial, or sex glands, the thymus, the parathyroids, and the pancreas, all of which normally act in friendly competition to maintain the delicate balance of our physical and spiritual being. They proceed very much like a meeting of a board of directors, some making motions which, even when seconded, may finally be voted down by the chemical ballots of the majority.

When no one gland exercises too much influence, we grow up as normal human beings, but to complex variations in their workings Doctor Berman traces many of the most striking differences between us.

If all the glands of the system stood the attacks of age equally well, there might be little trouble in enabling us mortals to repel the assaults of the years much better than we do. Here and there, however, owing to local causes, the glands often get into a wrangle, and the disposition of their human host begins to suffer. He finds himself taking on odd characteristics due to the weakness or the strength of the quarreling directorate.

This often blind, but sometimes seemingly purposeful struggle of the glands may create geniuses, or it may create idiots. Four of the former—Napoleon, Caesar, Nietzsche, and Darwin—Doctor Berman explains in terms of their glands, mentioning chiefly thyroid, pituitary, and adrenals as the source of their powers and failings.

Glandular Influence Is Very Strong

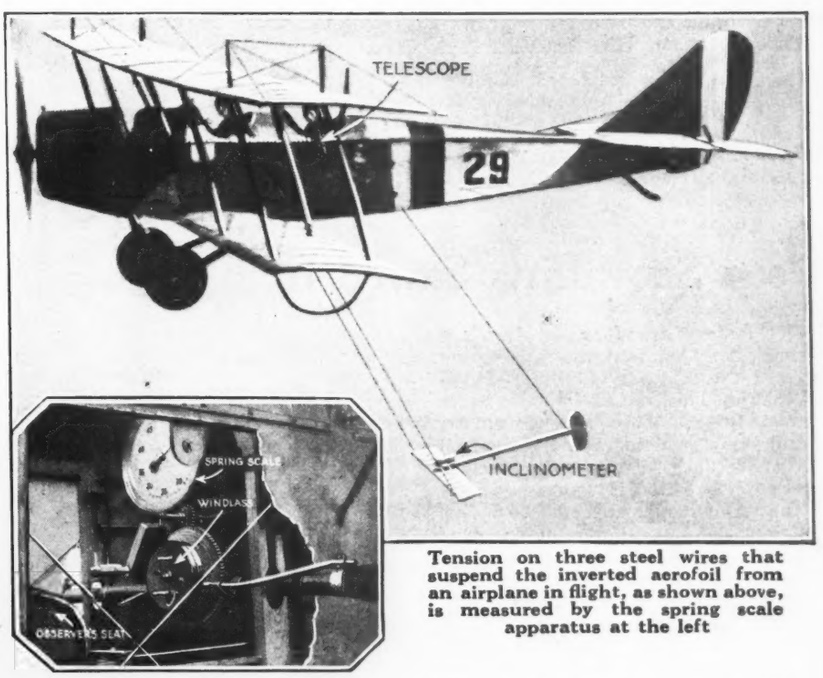
Cautious critics declare that many specialists will be skeptical of the more sweeping claims in this new theory that finds in the glands the wellsprings of our whole personality. But its exponents convince us, at least, that the glands all have remarkable effects at various stages of the careers of human beings; that these hidden organs certainly are kept under constant stress and strain in the lives of men and women who think, plan, and achieve in this world; and that old age results, in its final analysis, from a sort of general strike in this strange chain of little chemical factories.

Modern "Efficiency" Invades Field of Palmistry

MAKING plaster casts of the palms of those who wish to learn what the future has in store for them is the modern method adopted by Madame de Sais, a seeress and fortune teller of Belgium.

All applicants place their palms on a plaster mold, and from this imprint the seeress forecasts their character and future. The reading is dictated to a stenographer, typed, and mailed to the person interested.

Airplane Tows Wing in Novel Test



Tension on three steel wires that suspend the inverted aerofoil from an airplane in flight, as shown above, is measured by the spring scale apparatus at the left

AN interesting method of testing aerofoils, or airplane wings, in actual flight, devised by the National Advisory Committee on Aeronautics, is described by the committee as follows:

"The method consists of lowering a large inverted aerofoil from an airplane in flight. Since the aerofoil is inverted, its "lift" makes it tend to dive down, away from the flying plane, and the amount and direction of this force can be measured by the tension put upon the three steel wires from which the aerofoil is suspended and the angle at which they trail from the plane to the model."

It is expected that wings spreading 30 feet can soon be tested as quickly at a speed of 100 miles an hour as small scale models have been tested in a wind tunnel.

The apparatus used for measuring the tension in the supporting wires consists of a steel tube connected by a pair of levers to a spring scale on the instrument board. In the center of the tube a windlass is attached for reeling up the wires. Two of these wires are fixed to the forward wing edge of the model, while the third leads to the rear of a wooden boom extending behind the aerofoil.

The angle of attack at which the aerofoil cuts the air, is varied by reeling in the rear wire. The angle at which the model trails, is read by a telescope with a graduated circle attached to the fuselage of the upper plane.

Improvements in airplane design have been dependent upon facts discovered by testing small models in wind tunnels. Until the present time airplane engineers have been hampered because their calculations have been based on behavior of models only a twentieth, or at most a tenth, the size of the actual machine. Such calculations have sometimes resulted disastrously.

New Tools Take Woe Out of Backyard Gardening

THE first spring burst of enthusiasm that carries thousands of American backyard gardeners over the planting season often wanes into indifference because of the everlasting hoeing and weeding that turn the otherwise pleasant task into drudgery.

But now modern scientific garden tools —newly designed wheel implements with effective attachments for speedy plowing, planting, and cultivating—are putting all-season fun into home gardening. Fifteen minutes a day with the new hand cultivator will keep the average "backyard farm" in first class condition.

Scientific designing, especially in the past year, has given the home gardener not merely a hand power adaptation of the large horse-drawn and power implements of the farmer, but also tools designed for his especial use.

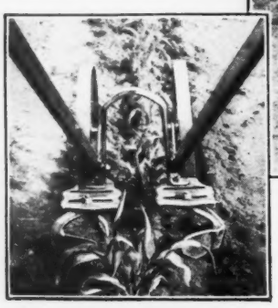
The first wheel hoes had a tendency to throw dirt over young plants and bury them. Slight but important changes in hoe blades, which are shaped not at all like an ordinary hand hoe, but more like an Australian boomerang, now protect the youngest plants.

This hoe is the most useful of all the attachments. It runs a thin sharp blade between rows one half or three quarters of an inch beneath the surface, cutting off weeds at their roots and at the same time pulverizing the surface of the soil.

For deeper cultivation cultivator teeth are substituted. Modern design makes the teeth next to the row shorter and narrower than the outside teeth to prevent disturbing the plants, while a staggered arrangement prevents the teeth clogging with dead weeds and rubbish.

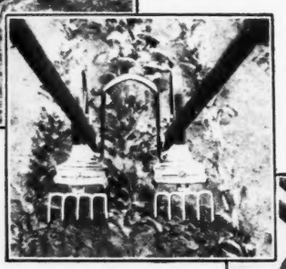
Two strangely shaped plows are provided, which when placed with their points together open a furrow with surprisingly little effort, and with positions reversed, cover up the same furrow again. A rake attachment is a back-saver of high order. The teeth of the rake also are staggered. A hand wheel pulverizer will save an enormous amount of labor in preparing the plowed soil for seeding.

The planting attachment, which works like a large commercial planter, sows in straight narrow rows. Furthermore, the seeds are deposited in the right number and at the right depth.

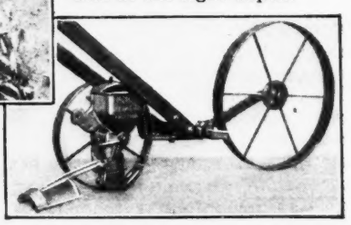


Shaped like boomerangs, these hoe attachments cut off weeds at their roots and pulverize the soil while protecting the plants

Scientifically designed, the wheel hoe, with its attachments shown on this page, is a hand power adaptation of the farmer's modern power implements. It saves hours of wearisome drudgery in the garden



For deep cultivation the above teeth attachments are used. At the right is the planter



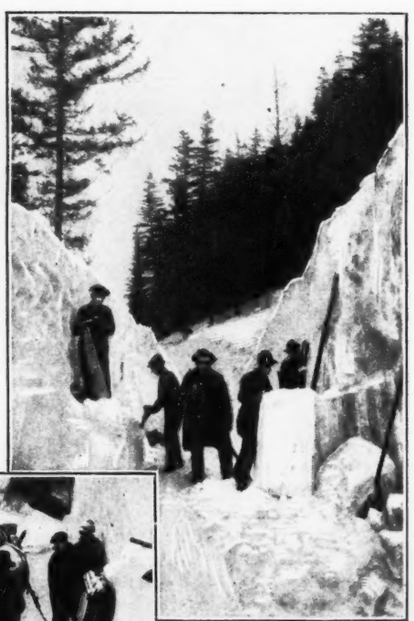
Deep Snowdrifts Sawed from Highway

USING crosscut saws for snow shovels, a small army of workmen this spring completed the removal of 40-foot snowdrifts that had blocked the Columbia River Highway, Oregon, since last November, and had threatened to close the road to tourist traffic until August or September.

The snow had settled into a mass so compact that its removal appeared to be an almost hopeless task until some one suggested attacking it with a lumber saw, cutting the solid snow from the drifts. The snow was sawed into blocks about three feet square, which were hauled away by a team of mules. The compactness of the snow is indicated by the fact that it was dragged for a long distance without breaking to pieces.

During the clearing of the highway, dozens of automobiles, abandoned by their owners last fall when the drifts became too deep for travel, were uncovered. The expense of making an open cut through this snow 40 feet deep amounted to several thousand dollars a mile, though the road was made only 10 feet wide, with occasional open spaces for turnouts.

The highway is a paved boulevard, running along the Columbia River for 175 miles.



Sawing through solid banks of snow from 30 to 40 feet deep, cutting drifts into huge blocks, crews of workmen finally succeeded in opening the Columbia River Highway in Oregon in time for spring tourist travel. The highway had been blocked since last November

Great blocks of snow sawed from drifts were hauled away by mules

Midget Size Blowtorch Is Self Generating

OPERATING without the pumps and valves that account for the bulk of the ordinary blowtorch, a newly perfected automatic torch seems toy size. The inventor claims that within a minute after it has been lighted with a match, it will operate without further attention from the user.

The tiny torch is self generating. When the burner coil on the top of the torch is lighted, about a minute is required to burn out the gasoline that has been absorbed by an asbestos wick. Before the wick goes out, the torch burner is heated enough to generate its own gas, a small portion of which is forced out through a small aperture in the upright portion of the coil. The balance of the gas is forced downward into the torch body, maintaining constant pressure that forces the gasoline or alcohol into the burner coil.

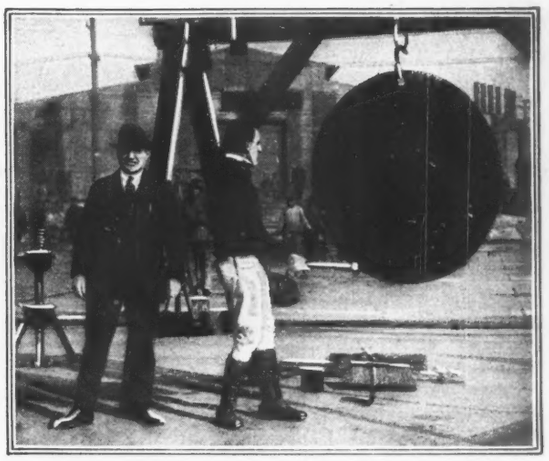
Within a minute after it has been lighted, this tiny blowtorch operates

How Gong and 250 Jacks Lowered Huge Iron Disk

BANG! A husky workman armed with an iron drumstick whacks a huge gong. At the signal, each of 250 men, stationed at hand jacks at equidistant intervals over a vast circular platter of sheet iron, turns the handle of his jack half a revolution—and the great, thin platter settles a fraction of an inch, without bending or buckling.

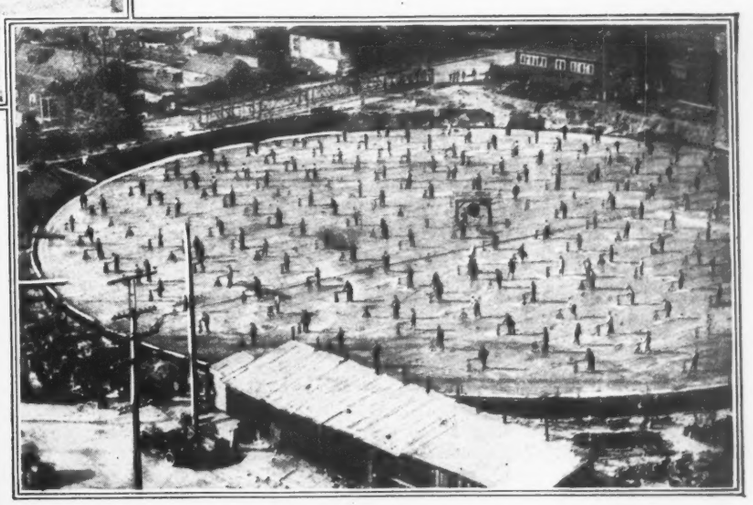
Such was the novel method recently used successfully by builders of a gas storage tank in Los Angeles, Calif., for slowly lowering a sheet of iron 273 feet in diameter a distance of three feet. This thin circle, forming the lining for the base of the tank, was built three feet above its concrete emplacement so that riveters might work on both sides in assembling the plates.

How the completed disk was lowered is described by the accompanying photographs.



In the center of the iron disk was hung the huge gong shown above. When the gong sounded, 250 jacks were turned simultaneously

Turning his jack screw with a long handspike, each man walked in a half circle whenever the gong sounded



How the 250 jack screws were spaced at equidistant intervals over the circular iron sheet. Each black spot is a man at a jack. The men were always in line; thus if any man turned too much or too little, the error could be quickly corrected.

At the left is shown one of the jacks placed about the rim. Within the circle the jacks were passed in an inverted position through holes bored in the sheet metal—that is, the "top" end of each jack rested on the concrete emplacement; its base was bolted to the iron

Padded Detectives Teach Police Dogs to Seize Fugitives' Wrists

The trainer wears two thick pads, one extending from elbow to wrist, the other covering the hand

AS a measure of self protection from stabbing or clubbing, police dogs are now being trained to seize fleeing criminals by the wrists, and as the result of skilful training, are developing amazing cleverness in thug catching.

A detective, wearing a padded suit, acts as the fugitive robber. The suit is shaped to teach the wrist hold. On each sleeve are two thick pads, one reaching from the elbow to the wrist, the other covering the hand. Thus the dog can catch hold only at the wrist.

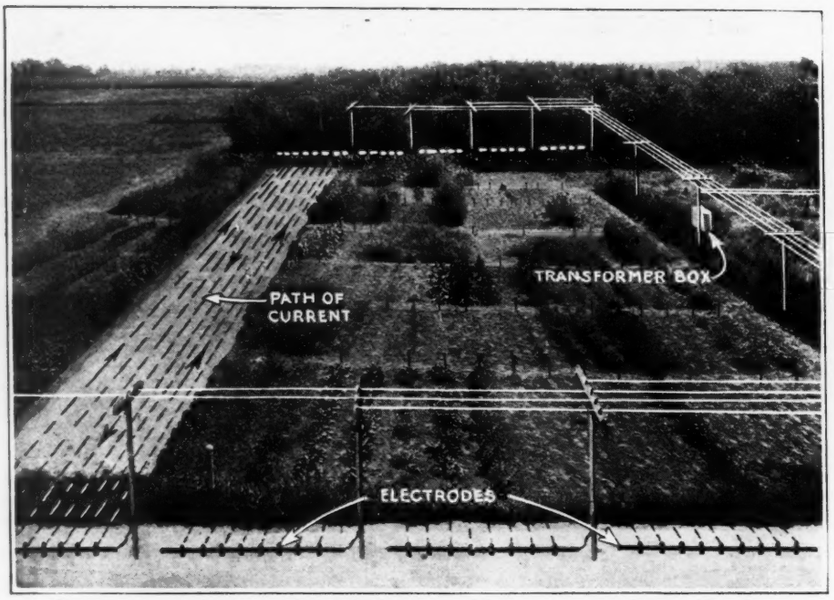
COMING—the day when you can run your car with any kind of oil for fuel—from castor to kerosene. Read about the new two-cycle, direct injection automobile engine, in this issue.

Because of the heavy padding, the dog attacking his trainer-fugitive can catch hold only at the wrist

Electric Waves, Like Sun, Make Your Garden Grow

ELECTRICITY, if properly applied, will act as a partial substitute for sunlight in raising crops. With the improved methods of application and control achieved by Robert S. McCreery, the costs are said to have been reduced to a point that will make electrical farming practical, even in growing bulky crops such as corn and wheat.

Sunlight is, of course, essential to plant growth, for it plays a necessary part in carbon assimilation, the process by which the plant builds up carbohydrates from carbon dioxide in the atmosphere. But modern research shows that charges of electricity sent through the soil will stimulate the plant so that it will grow larger, more quickly, and possess increased food value and sugar content.



Current passes in waves through the ground between rows of metallic plates on two sides of the planted field and is collected at the plant roots

The value of electrical farming seems to lie in the fact that the earth currents "fix" atmospheric nitrogen directly around the plant roots. This provides fertilizer at the points where it is most needed.

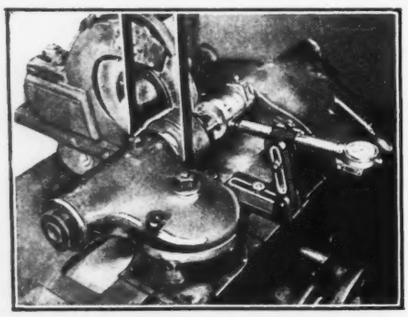
In its latest form, the electrification apparatus utilizes static electricity in the form of high frequency impulses like radio waves, which are collected at the plant roots by a metallic coating applied to the seeds before they are planted. The metallic element also collects stray earth currents emanating from the "grounds" of electric apparatus in the neighborhood. Enough seed for 20 acres can be coated in 10 minutes, it is claimed.

The electrical apparatus consists of an oscillation transformer with a rotary spark gap that converts an ordinary lighting voltage of from 110 to 220 volts into a high frequency high voltage current. The current is led over wires to rows of metal plates about three feet apart and nine inches deep at two sides of the field to be electrified. The current collecting on the metal plates produces an electrostatic region in the soil between the plates, thus distributing the charge uniformly throughout the field. The seeds, which have previously been coated with a metallic substance, absorb some of the electrical charges with a resulting increase in growth.

The usual method of installation is to place the transformer in a small portable weatherproof house, like a telephone booth from which temporary wires are run to the area to be electrified.

The current is used in each field about four hours each day, and a time clock on the transformer automatically throws the switches that change the current supply from one area to another. Under this system, the average cost of operations an acre, using the current four hours a day for 100 days, and figuring the cost of power at eight cents a kilowatt hour, is reported to vary between 45 cents for rye and barley to 65 cents for cotton and corn, including the cost of coating the seeds.

The result is a marked increase in productivity. In a comparative test made on two adjoining fields of corn, the field treated with electricity sprouted four days sooner, grew between 30 and 40 per cent more rapidly, and increased the germination from 31 to 39 per cent. The increased grain production was estimated to be no less than 30 nor more than 40 per cent, so that the increased money value of the crop was between $25 and $35 an acre. The average height of the electrified corn was over 10 feet, and the yield was 60 bushels to the acre.



Gage Measures Cylindrical Work to a Split Hair

GAGING cylindrical work to the thousandth of an inch while it is in motion in the lathe is something few machinists consider possible; yet such precision in measurement is claimed for a newly invented gage, even while the grinding-wheel is at work on the other side of the stock.

The instrument is clamped to the bed of the lathe. A clamping and slotted adjustment arm in the frame allows it to touch the work at any desired angle. The measuring bar proper ends in a rotating steel cylinder that presses against the work, and the movements of the bar are registered automatically on the dial in thousandths of an inch.

Automatic Machine Pastes Labels on Bottles

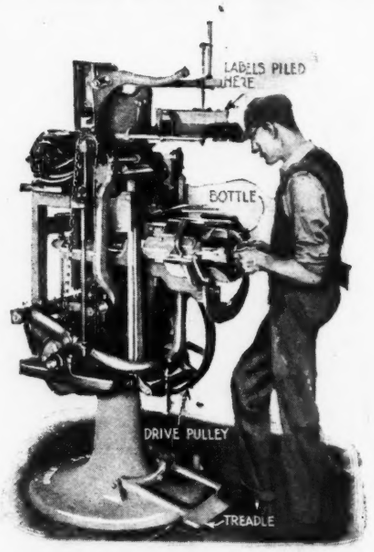
BOTTLES of all sizes are automatically supplied with labels by means of a new machine that pastes the label on every bottle in exactly the same position—an important feature if goods are to be displayed. The labels, carried in a box near the top of the machine, are removed one by one by "pickers"—gummed and automatically applied to the bottles as fast as they can be fed to the machine.

The label holder accommodates a thousand labels. Liquid paste is poured into the reservoir, in which a brass roll revolves to keep the gum at a flowing consistency. As the machine starts, a soft rubber roll connects with the brass gum roll and then swings forward to the label pickers, spreading a film of gum over their surface.

Labels Pressed on Bottles

The "pickers" take the labels out of the holder, the gum adhering to and pulling only the bottom label from the pack.

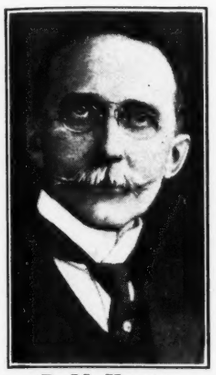
While the pickers are at their highest point, the operator places an unlabeled bottle in the bottle rest underneath. Then, as the pickers start downward, a soft rubber cushioned grip finger swings down between the pickers and above the label, and this presses the center of the label firmly to the bottle. A pair of wipers then come in from opposite sides and wipe the label. The operator removes the bottle from the machine and puts another in its place. The machine has a capacity of from 20 to 45 bottles a minute.



On each revolution of the drive pulley this machine labels a bottle

Tips to Young Inventors from One Who Knows

"The Little Improvements that the World Needs Are the Ones that Pay," Advises Rudolph M. Hunter, America's Third Inventor



R. M. Hunter

NOT many years ago a bright-eyed man with a vivid imagination stood on a street corner and watched a horsecar lumbering by. A little while later, on another street, he observed a slowly moving cable car. Then he went home, shut himself in a workroom, sat up with sheets of figures and drawings far into the night seven days a week and finally went to the heads of a street-car company, operating in Chicago.

"Why," asked the man with the imagination, after he had introduced himself as R. M. Hunter, of Philadelphia, "Why not propel your cars with electric motors? I have the plans here—"

Apparently he was ahead of the times and the men he was talking to weren't ready to listen.

But to-day the visionary Rudolph Melville Hunter is one of America's leading inventors, and he is 100 per cent thorough business man and 100 per cent interested in practical matters. His inventions run from distillery plants to blast furnaces and gas-manufacturing processes. He is known as the third most prolific inventor in America, and is credited with having designed the first motion-picture projector, the first slot machine, numerous submarine devices, and an alternating transforming system of electrical transmission.

"Most young men," he explained, in a recent interview for POPULAR SCIENCE MONTHLY, "look to the impractical. They don't give enough attention to the demands of the market. Most of them think too much of startling the world with something radical.

"The young inventor should spend more time looking about him to see what is needed. The inventing can be done after the need is discovered. Then the market is ready to absorb the invention; and the inventor receives his financial reward at once.

"All young men will say to themselves: 'Well, how do I know what manufacturers want?' First, I would advise the young man to select a business or an industry in which he can become interested. He should begin by learning everything about this industry. Let us assume the young man of whom we speak has selected concrete construction work as his business. He gives it his undivided attention until he knows all its ramifications. Then he applies to the United States Patent Office for copies of all the patents granted in concrete work—from molds to mixtures. This information, coupled with what he has learned from observation, work, and books, gives him the foundation from which he may develop his own ideas. He knows what has been done in the line of improvement, and it will not be long before he will see where other improvements can be made in the development of machines and mixtures. The manufacturer is watching for young men who have suggestions for improvements and his ideas in patented form will be snapped up quickly."

Mr. Hunter called attention to the fortune made by the inventor who thought out the idea of punching a hole in the head of the needle, and to the quarter of a million dollars that fell to another inventor who first amused his children with the "return ball"—the little rubber ball on the long rubber thread.

"Every young man in the world is a potential inventor," he said. "Many inventions come spontaneously, while others require many hours of work and considerable experiment.

"The attention of every inventor in the world will turn to the development of means to insure greater production with less labor," Mr. Hunter predicted. "I expect to see such things as concentrated foods do away with a kitchen in the modern home as the result of new chemical processes and new machinery. The work of the inventor will reach to new levels such as transmutation of elements. The day will come when a shovelful of coal will be made to surrender as much energy as we now receive from 1000 tons.

"But the young inventor mustn't bother with such big things," he warned. "The little things are the ones that pay—the slight improvements on existing machines, the 'specialties' that sell readily. And above all, he must have patience."

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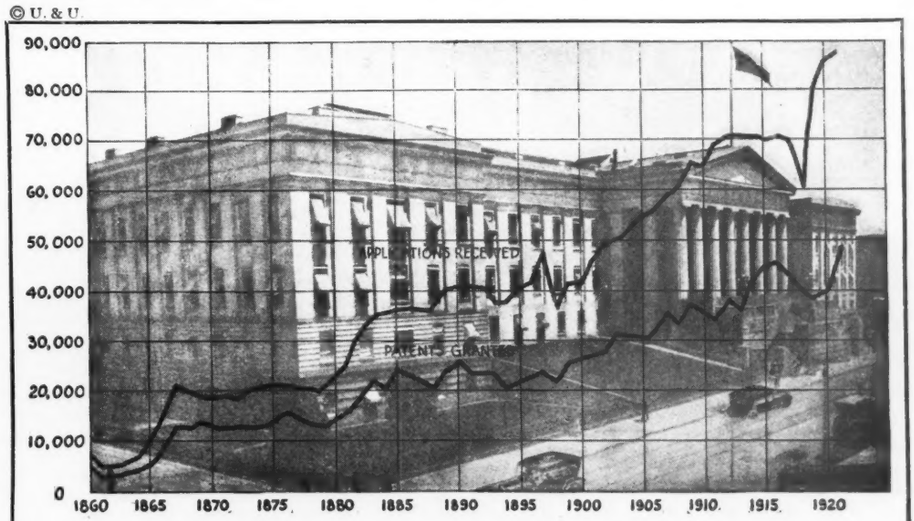


Patent Office Speeds Its Clogged Wheels

INVENTORS, young and old, whose efforts have been all but stifled during recent months by the inefficiency of the government Patent Office, will find promise of relief in the above chart, which gives assurance, more clearly than words, that the clogged machinery for granting patents is at last beginning to turn more rapidly.

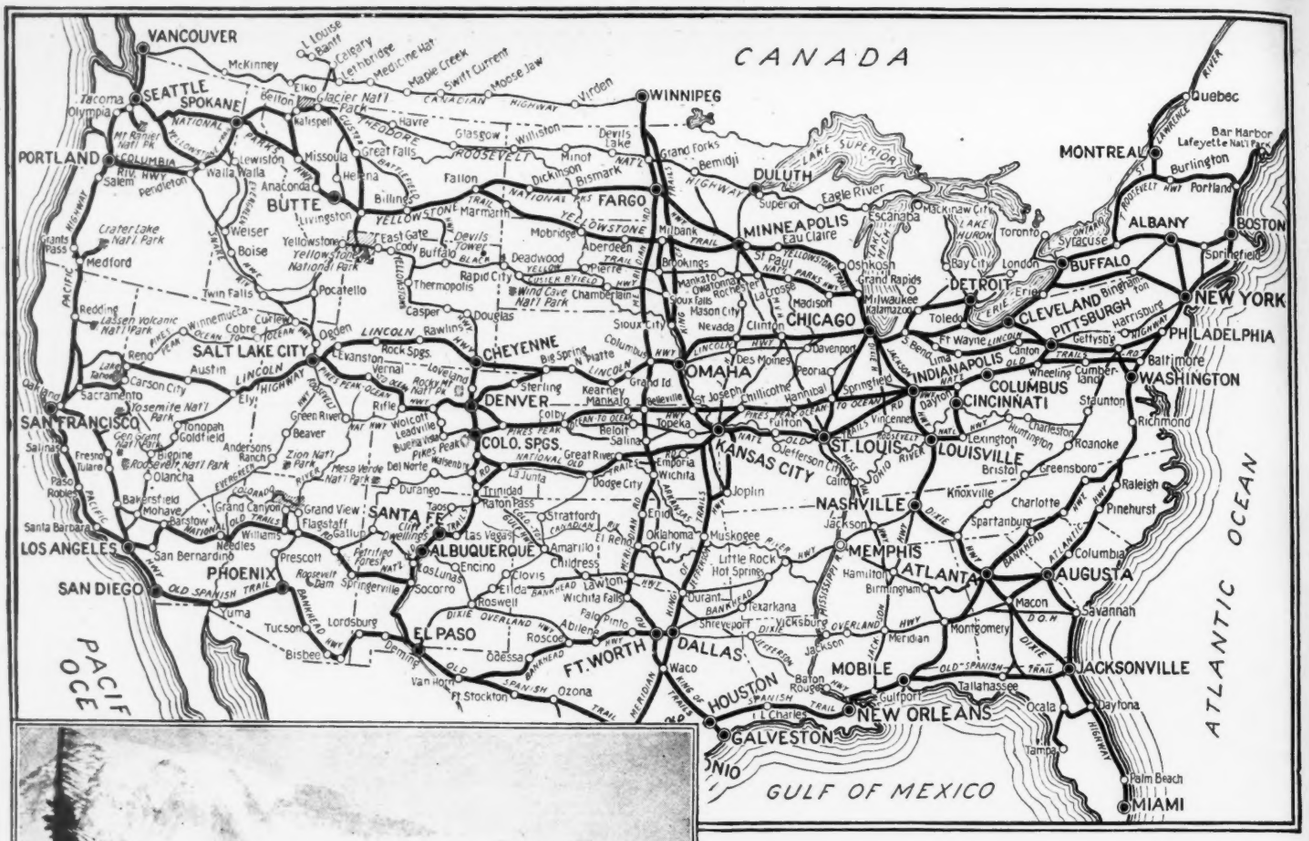
Beginning with 1920, the sharp and steady upward climb in the line denoting the number of patents granted, in relation to the increase in applications for patents, indicates not only a reduction in the heart-breaking delays that have spelled hardship and disappointment for hundreds of struggling inventors, but also a striking spurt in inventive energy since the World War. Incidentally, it may be noted from the chart that similar increases in inventive activity followed soon after the close of the Civil War and the Spanish-American War.

But that there is still urgent need for drastic speeding up of the Patent Office machinery in making the best ideas of our inventors available is shown by the fact that at present there are 64,201 applications for mechanical patents awaiting action. The relief granted the Patent Office by Congress in the way of an increased appropriation will not expedite the handling of patents radically for one or two years, as it will take at least that long for government experts to clear their desks of the accumulations of the past 18 months, in addition to caring for new applications.

Every year recently the Patent Office has been falling behind in disposing of applications, until today it is swamped. The reason for this may be seen in the fact that the increase in applications for patents in 1921 over 1918 was 53 per cent—the equivalent of more than 30,000 additional applications—while the increase in employees in the Patent Office from 1918 to 1921 was only 4.5 per cent, a reenforcement of expert workers that was entirely inadequate, and relief is only just in sight.

Yet from under the ever accumulating mass of applications, the Patent Office, as the chart reveals, is striving desperately to extricate itself. The task has become increasingly difficult because of the rapid rise in popularity of the radio telephone, which has been reflected in hundreds of new applications for radio patents in the past six months. During the past year an average of 100 applications a month in this line alone have been received.

In this situation the encouraging feature right now for inventors is the fact that the number of patents granted, in proportion to the number of applications received, is actually increasing.



Where to Go and How to Get There

This Map of Our Highways Tells You

WILL you be one of the 10,000,000 tourists who will spend this summer's holidays in the woodlands of Uncle Sam's great national parks?

If so, you will want to know just how to get there—the most direct highways to follow and the camping places available along the route.

The map above, prepared by the American Automobile Association, will give you this information, picturing as it does the network of roads linking America's playgrounds, as well as the convenient stops.

Four million tourists, statistics show, spent 10,000,000 vacation days in our national forests last year. The opening of new national pleasure grounds, and availability of ideal camping sites such as that shown at the left, will attract tourists in record numbers.

Our New National Parks Beckon Auto Campers

Uncle Sam Opens Magnificent Playgrounds to Motor Vacationists

KEEPING pace with the amazing increase in popularity of our national parks as summer play spots, Uncle Sam recently has opened remarkable new forest playgrounds for the pleasure of automobile vacationists and campers who will this summer ramble over the highways of the United States in unprecedented thousands.

No country in the world can boast such a variety of national parks with such varied scenery as the United States. Our latest acquisitions include our only national park in the East, embracing the only group of granite mountains on the Atlantic coast; the highest mountain in North America; the only active volcano in the United States proper; three volcanoes of world fame; a great and fascinating area in the Southwest, including the magnificent Zion National Park, still almost unknown territory to travelers; and finally the Grand Canyon National Park, popular for years, but only recently made a national park. Two of these parks lie outside the United States proper—the Mount McKinley National Park in Alaska and the Hawaii National Park with three world-famous volcanoes. Many of them, however, are easily accessible to any family with an auto camping outfit, and can be visited the year round.

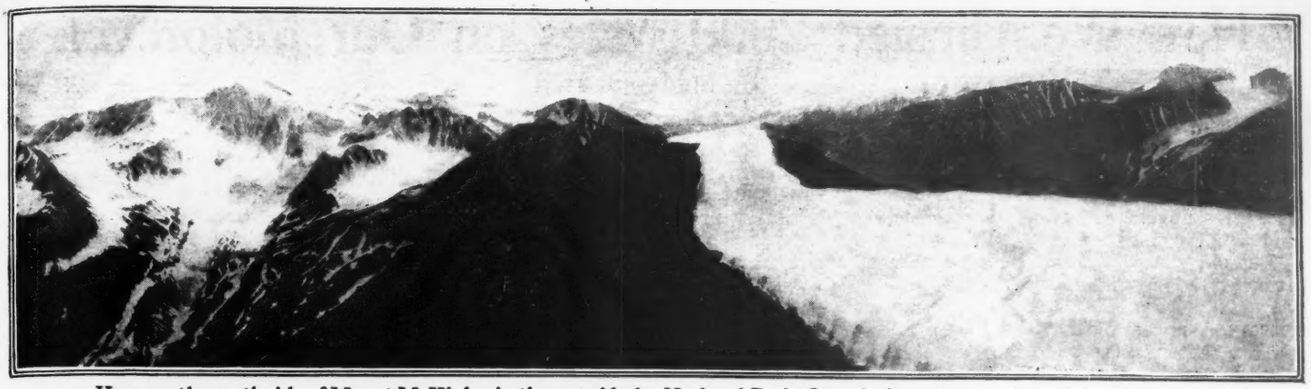
The East's New Playground

Of immediate interest to the greatest number of people is the new Lafayette National Park in Maine, the only national park in the eastern half of the United States.

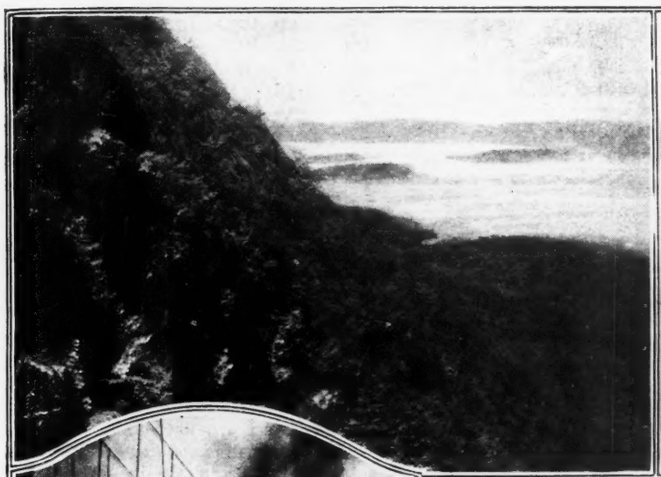
Located on Mount Desert Island, near Bar Harbor, this forest playground is in the very heart of the summer resort section of seacoast America. The park itself embraces about 10,000 acres, half of this having been donated recently by private individuals. There are rugged granite mountains, deep gorges, open meadows, seacoast and woodland—in fact, few places in America contain such a variety of scenery. There are 100 miles of trails through the park and a fine automobile road has been constructed around the island.

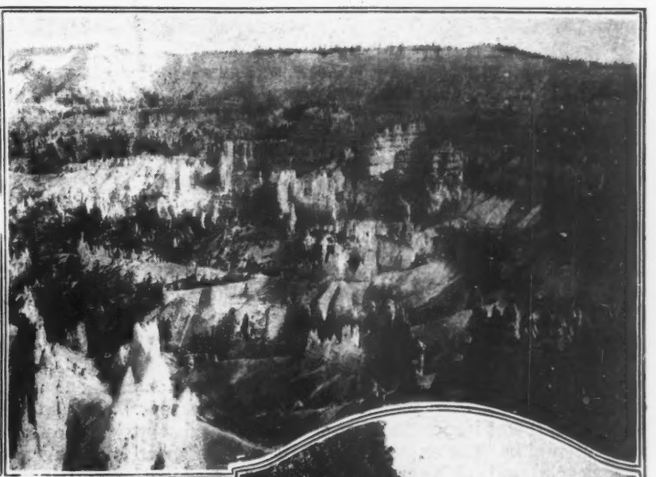
The present plan is to make the feature of this park the encouragement of water sports. Within a few years it is expected hundreds of vacationists will come here and live in houseboats for the summer, just as in other national parks they travel and camp by automobile. Since the waters surrounding the island are government waters, the problem is greatly simplified. Many attractive islands and inlets surrounding the park may gradually be added to its domain.

In the Southwest, land of the painted desert and the purple sage, two new national parks have recently been dedicated. One of these, the Grand Canyon National Park, has long been familiar to most persons simply as the Grand Canyon of the Colorado, but the Zion National Park, in

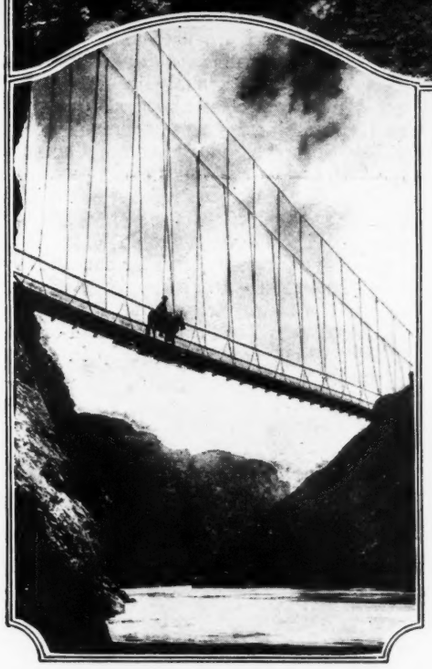


Here, on the south side of Mount McKinley in the new Alaska National Park, flow glaciers of great size, while on the north and west the mountain drops abruptly to grassy valleys. Mount McKinley rises 20,300 feet above sea level

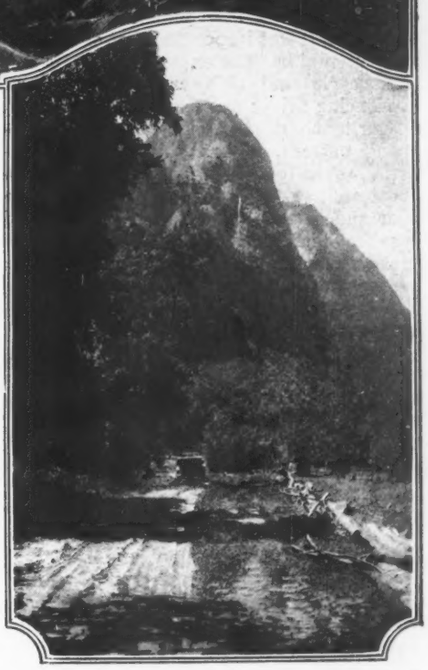




The view from Precipice Path in Lafayette National Park, Maine (upper left), is one of rugged granite mountain sides and seacoast. Far different are the gorgeous deserts of Bryce Canyon in Zion Park, Utah (upper right), with its castle-like formations chiseled into sandstone and splashed with many colors



This 500-foot suspension bridge across the Colorado is an important development in the Grand Canyon Park



"The Temple of the Sun," seen in the distance, is one of nature's colossal monuments in Zion Park

southern Utah, is a new development that few have visited.

The most important development in connection with the Grand Canyon National Park has been the erection of a 500-foot suspension bridge across the Colorado River for the use of trail riders. This now makes it possible for one to visit both the north and south sides of the Grand Canyon, which was not possible in the old days, unless one rode in a car suspended from a cable, a nerve racking experience for the uninitiated. The erection of this bridge is also important, since it means that one can visit Zion National Park, then cross and see both sides of the Grand Canyon.

Starting from the railroad station at Lund, Utah, within 20 miles of Zion National Park itself, one comes into view of the West Temple, a great red and white monument of natural stone, towering nearly a mile above the canyon floor. Giant sandstone cliffs with brilliantly contrasting colors make Zion Park a spot of rare beauty. These cliffs are often a bright red two thirds of the way up, with the summits topped off with white rock. Occasionally at the base are purple hues.

The new park contains approximately 120 square miles. The canyon of the Mukuntuweap River is about eight miles long, with walls rising to a height of 800 to 2000 feet on either side. Everywhere are these colossal monuments—the Vermilion Cliff joining the White Cliff, the Three Patriarchs, the Brown Wall, Angel's Landing, and El Gobernador. El Gobernador is the remarkable monolith of the park, a great dome of red and white.

Free Tourist Camping Ground

Zion National Park and the journey to and from it give one a vivid idea of the great desert country of the West. A free tourist camping ground is provided, as well as a more permanent camp where regular lodging and meals may be obtained.

If one desires to vary and extend his trip a little, he may visit Bryce Canyon, located to the northeast of Zion Park, and sometimes called the most gorgeous spectacle in the world. It is a canyon two miles wide by three miles long, cut 1000 feet deep in the plateau. All sorts of castle-like formations have been chiseled into the sandstone and splashed with nearly every color, including reds, tans, and purples.

As yet, few tourists have visited our Alaska national park, Mount McKinley, but with the completion of the railroad in that section more and more visitors will journey there in the summer. The park embraces the highest mountain in North America and will preserve at least a glimpse of primeval Alaska for posterity. Mount

(Concluded on page 58)

How We Gipsied 2000 Miles on Our Motorcycle

By Sidney J. Hall

A 2000-mile road journey, with a tent in the open air as your hotel at every stopping place! You immediately have visions of an automobile loaded down to the runningboards with tents, blankets, and camping paraphernalia, don't you?

But did you ever consider that such a camping trip over the highways is just as possible for a motorcycle and side-car as it is for an automobile, and that you can enjoy the thrilling, health-giving new sport of gasoline gipsying on three wheels almost as comfortably as on four?

We—my wife and I—proved that long jaunts on three wheels are not only possible, but thoroughly enjoyable, when we made the journey, without a hardship, from New York City to Denver, Colo., with our 1918 motorcycle and its side-car.

Equipment and the means of transporting it, of course, were the chief considerations for a successful journey. The requirements were facilities for sleeping comfortably under adequate shelter and an outfit to provide ourselves with well-cooked meals. At the same time it was important that our equipment should be light enough to ride on the motorcycle and side-car without inconveniencing driver or passenger.

Our tent was of the satisfactory "sportsman" pattern, of brown, waterproof material, seven feet long, five feet wide at the front end, two and a half feet wide at the rear end, five feet high at the peak, and two feet high at the bottom. The ground cloth was sewed in, making the tent completely water-, wind- and snakeproof, while the two side windows and the door were protected with bobbinet to keep out mosquitoes and other insects. When folded up, the tent measures about 12 by 18 by 4 inches, and weighs about eight pounds. We used six steel tent pegs and tenpenny nails, about six inches long, for the side pegs.

Sleeps and Eats Provided For

Our bedding consisted of two heavy wool blankets apiece, and about a dozen large horse-blanket pins to fasten the two pairs of blankets into two sleeping bags. Our cooking equipment included a portable stove (quart size) burning kerosene, a coffee pot, a small saucepan, an eight-inch frying-pan, and a little egg pan, two granite plates, two granite cups, two small granite bowls, knives, forks, teaspoons, dessertspoons, and a can-opener. Don't forget the can-opener. Rather leave your tent behind!

We carried also an axe, a folding camp lantern, a canvas water bucket, a one-gallon canteen, and air pillows. All these, except, perhaps, the water bucket, are absolutely necessary equipment. Don't depend on using the headlight of the machine for illuminating the camp. It is all right up to a point, but you can't carry it about with you.

We camped the first night in a little sylvan glade off the main road. We found the best way to select a camp site was to drive a mile or so down some side road

Packing Was a Simple Matter

How to carry all this impedimenta was a problem. We solved it in this way: We used two duffle bags and a small suitcase. Two blankets were packed in the bottom of each duffle bag. In one were packed our spare clothes (rolled up, service fashion), our toilet requisites, and sundry other items of equipment that would not be required immediately upon making camp. In the other and larger bag were packed all the things that ranked as camp equipment—including cooking utensils. The stove occupied its own tin box, while the tent, axe, and pegs were in the tent bag. The little suitcase was packed with the stove box, the cutlery, and one or two cans containing butter and the other soft food.

The machine was provided with two carriers: one over the rear wheel of the motorcycle, and a larger one at the rear of the side-car. On the smaller carrier were placed the suitcase and my oilskin coat. On the large side-car carrier went the big duffle bag and the tent. A large strap held them down firmly to the carrier, while two ropes, fastened to the corners of the carrier, crossed, and secured to ringbolts on each side of the side-car, took much of the weight and held all snugly in place. Inside the side-car were placed the smaller duffle bag, the canteen, and a can of engine oil. The camera, maps, etc., rode easily in the crack of the side-car cushion, and the tent pole was lashed to the chassis. We weighed 1000 pounds all on, including passengers.

I carried a full complement of tools for the motorcycle and spare drive chain links, a vulcanizing outfit, a spare tube, a valve spring, valve insides, a spare spark plug, some tire tape and a roll of soft iron wire, together with a liberal supply of nuts and bolts.

Once on the trip, my passenger complained of the side-car bumping down on the chassis whenever we passed over an unusually large jog in the road. This clearly denoted that the springs were overloaded. Instead of putting another leaf in the large C-springs of the side-car I procured an old tire and placed it between the side-car and the chassis, lashing it firmly in place. This acted as a first-class shock absorber, and no further difficulty was experienced.

The motorcycle purred steadily on, making from 100 to 150 miles every day.

Gas, oil, water, and food were obtainable all along the route. Never were there more than 30, or at the very outside 40, miles run between gas stations. Water could always be obtained at the ranch houses. Above all, during the touring season we found there are lots of cars along the roads, and one can absolutely rely on getting help in case of mishap.

This Investment Paid Big Dividends

On our 2000-mile trip we averaged 40 miles to the gallon on gas, and 266 miles to the gallon on oil (this, I think, was rather too heavy consumption). Our food bill came to about 50 cents each a day, and our dividends were found at the end to have been new health, open-air recreation, adventure, and pure joy on a phenomenal scale—very satisfactory returns when one considers the small capital invested.

Uncle Sam Opens a New Park

(*Concluded from page 57*)

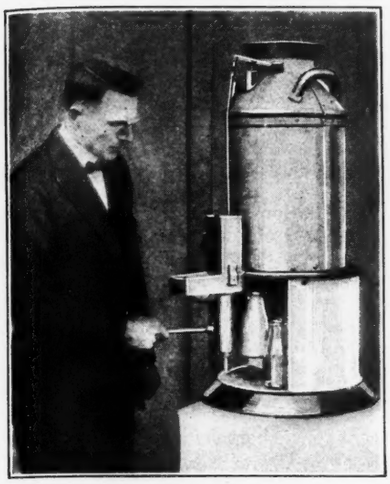
McKinley rises 20,300 feet above sea level. On the north and west sides the mountain drops precipitately to grassy valleys with an altitude of only 3000 feet—a spectacle unequaled by any other mountain area in the world. From the other sides of the mountain flow glaciers of great size. The wild animals are unusually abundant. There are herds of 1000 and 1500 caribou, or American reindeer, roaming the plateau. An ordinary day's journey will show 500 or so mountain sheep, as well as moose and brown bear.

The last of our new national parks is the Lassen Volcanic National Park in California, for which Congress made its first appropriation only last year. Lassen Peak, with its altitude of 10,465 feet, is the only active volcano in the United States. The last violent eruption occurred in 1915. Hot springs and mud geysers may be seen.

The peak itself rises 5000 feet above the surrounding valleys. Eleven miles northeast is Cinder Cone, 600 feet from base to summit, and surrounding a crater 250 feet deep. Many volcanic bombs are strewn about. There is also the Devil's Kitchen, a hillside and valley of mudpots and miniature mud volcanoes. One enters the park from Chester, an attractive little village, which in turn is reached by automobile stage from Red Bluff or Chico.

With the completion of the Park-to-Park Highway, linking the national parks in the western half of the United States, many American tourists have taken the family automobile and visited all of them in one season. Nor would it seem out of the way that the United States should begin to attract foreign tourists to American parks in much the same way that Europe has sought American tourists in past years. Switzerland is often said to live on its scenery and Canada's fourth income maker is also said to be her scenery. The United States might well divert international travel to its parks, and to some extent this is being accomplished.

Street Corner "Cow" Gives Milk for a Nickel



SLOT machines that dispense ice cold milk at every street corner may become as common as the gum-vending machine, for a nickel-in-the-slot milkcan has recently been invented and approved by health inspectors.

The purchaser places an empty bottle under the neck of the machine, deposits a nickel, and pulls the lever. A nickel's worth of milk is poured into the bottle. The milk in the container is kept cold by a surrounding watertight tank filled with ice, on the principle of the water cooler. A large flushing box just over the spout thoroughly washes it with water after the bottle is removed.

Cannon Balls Refused to Stay Chained

LONG before the invention of the machine gun made it possible for two or three soldiers to delay the advance of an entire regiment, a double barreled cannon, still preserved in a Georgia city, was designed to mow down an attacking force by companies and regiments. It was cast during the Civil War, but never saw service.

The plan was to fire the two barrels simultaneously, using two cannon balls chained together. As the barrels diverged at a very small angle, it was expected that as the projectiles separated they would extend the chain between them, cutting a path 20 feet wide through the enemy.

No chain was strong enough to hold together two cannon balls fired from double barrels

In practice, however, the barrels could not be fired at exactly the same instant, and no chain could be forged strong enough to hold the cannon balls together.

Salesman's Auto Is Display Room

BY turning the rear deck of his runabout into a display room, an American salesman is carrying heavy machine tools direct to the prospect for demonstration. In this installation, a platform of oak boards 1½ inch thick was bolted to the chassis and a special folding metal cover arranged for protection from rain and dust.

The machine being demonstrated is a new, compact grinder for auto repairs, extremely accurate.

The grinding wheel is driven by a small electric motor, using power derived from the car's storage batteries or an electric-light circuit.

Machine Taps Eight Holes in 20 Seconds

A MULTITAPPING machine that will tap eight holes to a depth of one inch in 20 seconds, with an output on a typical axle job of 48 pieces an hour, is doing for tapping what the multidrilling press—now familiar in modern machine shops—has done for drilling.

A feature of the invention is an independent change of speed to each individual spindle, so that the feed and rate of revolution can be adjusted to the requirements of the hole being tapped. Taps not in use are thrown into neutral, saving wear and power.

The number of holes that can be tapped at one setting ranges up to 24, and the average time of placing the jigs on the boring table is said to be about 55 seconds in the manufacture of automobile parts such as cylinder blocks and transmission cases.

Blueprint Machine Sets New Speed Record

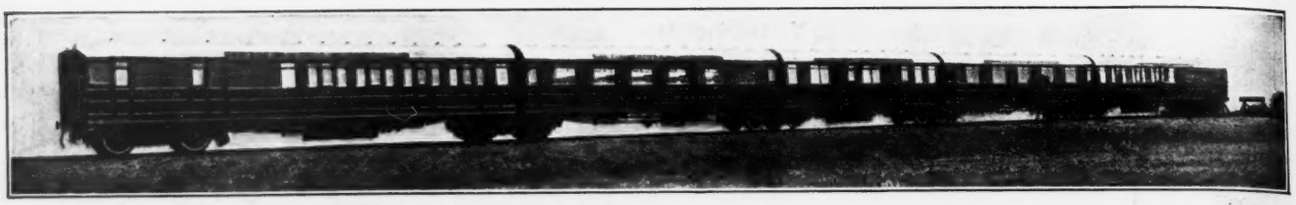
AN improved, continuous blueprint machine, that will print from 24 to 30 inches a minute or about 300 square yards of blueprints a day, gains its speed by means of a double lamp and an improved arrangement of feed rolls that keep the paper in contact with the printing roll over 92 per cent of its circumference.

This machine's daily output is 300 square yards of blueprints

The cylinder is made of open mesh wire wound right and left from the center. These outward spirals stretch and spread the tracings and paper without attention, and the use of mesh makes a cooling fan unnecessary, since the heat generated by the lamps is promptly diffused. The lamps are placed within two inches of the paper to conserve current. As the intensity of illumination varies inversely with the square of the distance, with eight amperes of current at two inches the new model obtains exactly the same effect as the usual machine with its arclights set five inches from the paper.

THE Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in POPULAR SCIENCE MONTHLY.

Five Coaches Ride on Six Trucks in "Articulated" Train



RAILROAD truck wheels of a new type that extend between passenger coaches so that the one truck supports the ends of two cars are a recent innovation on the Great Northern Railroad in England, where, it is claimed, they have resulted in a saving in weight and greater riding comfort. Five cars are permanently coupled, forming what is called an "articulated" train.

Under each end of the ordinary car is a four-wheel truck, making 10 trucks in a five-car train. In the new articulated train, the standard truck is placed near the ends of the front and rear cars in the usual manner, but at each of the four points where the intermediate cars are coupled is a single truck to which both car-ends are secured. This design eliminates four intermediate trucks. Beside the saving in deadweight, which amounts to 14 tons, the greater distance between the wheels reduces the oscillation and jolting to a minimum.

The ends of the truck underframes are supported on transverse rolled steel channel beams and to the center of each beam a steel bracket is bolted. The bracket is made so as to constitute a universal cup-and-ball joint that permits the ends of the coaches to swivel upon it when rounding curves. The joint also takes the pull so that usual drawbar gear is dispensed with except for a short safety chain.

Limousines Now Have Sliding Windshields

AN automobile windshield that rises vertically, traveling in grooves in the front of a limousine, and controlled by turning a butterfly nut placed above the glass, is an innovation in several custom body jobs recently completed by an American maker.

The sliding pane is hung on two wires that run over pulleys in the upper corner of the frame to the reel in the center.

Here's a Screwdriver that Will Not Slip

AN inexpensive screwdriver that will not slip has been devised by employing a set of detachable shanks of various sizes that fit over the head of the screw.

One end of each shank is formed into a circular head, with a web or wall across the center. This web fits into the slot of the screw, and is held in place by the wall of the shank, which fits so closely over the screwhead that slipping is impossible.

The web-and-wall construction makes it possible, also, to use the tool for the removal of screws with broken heads.

What Do You Want to Know?

Ask Us about Your Radio Problems

Don't Increase the Voltage

If I feed a slightly higher voltage to my audion filament, will the signals be increased?—M. I. T.

Unless conditions are exceptional, the answer is, no. Bulbs are designed for use on a potential of six volts and the only effect of increasing the voltage is to shorten the life of the filament.

Distance of the Horizon

How far away is the horizon when a man six feet tall stands on the shore at sea level?—A. J. C.

According to figures prepared by the Department of Commerce, the imaginary horizon line would be 3 1-5 miles distant.

Do You See Strange Shapes?

What is the cause of the peculiar shapes that can be seen by some persons directly in front of their eyes? They appear to be of various forms and are always moving.—O. L. E.

These spots are usually noticed on brilliant days in air that is full of floating dust particles.

The particles are minute fibers and specks of dirt that have fallen upon the outer covering of the eye. If a person is able to bring this covering to a focus, the particles will appear as sharply defined images of peculiar shapes.

Using Up the Battery

Should a storage battery be used until it is totally discharged?—B. R. M.

Lead batteries are harmed by full discharge, but the Edison nickel-iron cell will withstand over- and under-discharge without injury.

Radio Valve and the Audion

What is the difference between the radio valve and the audion?—T. A. Y.

The valve, invented originally by Fleming, consists of a filament and a plate. Later DeForest conceived the idea of modulating the electron flow by inserting a third element called "the grid." To this three-element vacuum tube he gave the name of "audion."

Some Frozen Fish Live

Will you tell our science class whether fish can be killed by lowering the temperature of the water?—E. T. C.

Scientists tell us that some tropical fish can withstand a variation of only a few degrees of temperature in the water in which they live. Other species, generally of the lower orders, are apparently unharmed by extreme changes in temperature. Some fish may be frozen solid and later thawed out, without any injury whatsoever.

The "Honeycomb" Tuning Coil

What are the advantages of the "duolateral" or "honeycomb" type of tuning coil?—J. C.

In these coils, the wires of alternate layers are separated by turns of wires that precede and follow the alternate layers, and the turns of each layer cross adjoining layers always at an angle. This decreases the distributed capacity of the coil and reduces the coil resistance to high frequency radio wave currents.

Linear Expansion

Will you please supply me with a list of materials having the greatest coefficients of linear expansion?—D. V. D.

Of the elements, sodium, phosphorus, potassium, and sulphur; and of organic substances, white wax, paraffin, gutta-percha, and hard rubber have the greatest coefficients in the order named.

How Oxides Prevent Weld

I should like to have you explain why it is necessary to rebuild a forge fire before welding iron if it happens that a metal such as copper has been previously heated in the coals?—R. E. B.

Before two surfaces can be effectually welded they must be clean and free from metallic oxides. A very small quantity will prevent a union of the surfaces. When copper has been heated in a fire, some of the particles may remain only to be later heated and vaporized.

If iron is placed in a flame containing copper, the latter will deposit on the iron surface and either prevent the union or weaken the completed joint.

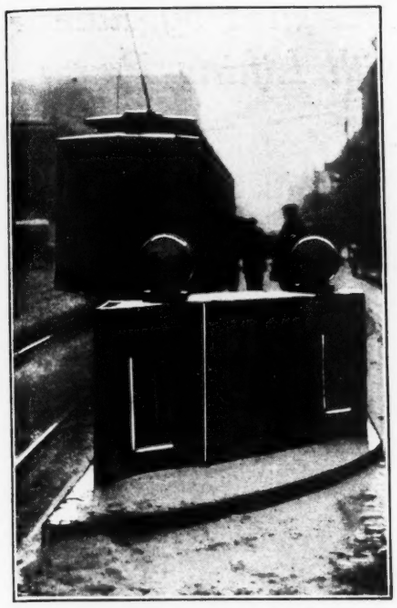
EVERY reasonable specific query in the field of general science addressed to the Information Department will receive a prompt reply.

While lengthy replies cannot be given to complicated questions involving extensive research or computations, this department aims to be of maximum service in supplying information as to what books or other sources may contain answers to these questions. Legal and medical queries cannot be answered.

A stamped addressed envelope must accompany each question, but the writer's name will not be published if he so requests.

Address the Information Editor, Popular Science Monthly, 225 West 39th Street, New York City.

Henry Ford in next month's POPULAR SCIENCE MONTHLY, has a startling message for every city dweller. No reader should miss this interview with the outstanding figure in America's industry.



Safety Bumper Guards the Pedestrian

RAISED platforms protected by heavy illuminated bumpers at each end guard pedestrians of Detroit, Mich., from careless automobile drivers. During the rush hours, certain crossings are blocked by crowds waiting for the street cars, and when a platform alone was installed, many accidents took place at night.

The safety bumper is built on an angle, and rises three feet four inches from the pavement. It is marked by two red lights.

Rapid Winding Reel Adds Sport to Fishing

A FISHING reel equipped with an enlarged, rapid-winding drum, against which the thumb can be pressed to serve as a brake in playing a fish, has just been invented by Lewis P. Mallow, of Wisconsin.

Instead of using gears, the inventor has devised a reel consisting simply of a thin plate of metal of large diameter, with brackets to hold the line.

The large diameter of the reel permits the line to be wound in so rapidly that the fastest swimming fish can get no slack, even when it heads directly for the fisherman.

Propeller Bolt Holes Bored Accurately

BORING bolt holes in giant steamship propeller blades is a cheaper and speedier process since J. J. Hendricks, of Seattle, Wash., invented a combined centering, graduating, and boring machine.

Exactness is an essential in a machine of this sort, for the pitch or curve of a propeller blade is very carefully calculated. Unless each blade is bolted to the hub at exactly the right angle, the thrust of the propeller on the water will be diminished enough to reduce the speed of the ship by many miles an hour.

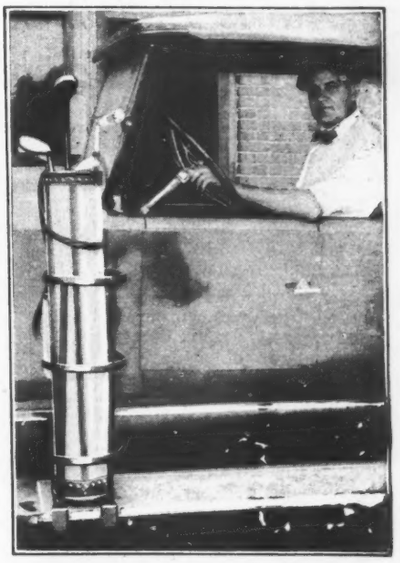
Formerly an expert worked from 40 to 50 hours to locate and bore propeller bolt holes. The new method completes the same work in 45 minutes. The blade is hoisted on the machine by a chain tackle hooked into the hole bored in the center of the blade. It is then clamped into place by three lugs on the face of the table, which accurately center the blade on the machine.

Clamped to the boring machine, the blade is adjusted by hand wheel

The next step is to locate a mark cast into the rim, indicating the point from which the position of the bolt holes is calculated. Starting from this point, the blade is turned the proper number of degrees, minutes, and seconds of angle. This requires only a few seconds, because the lower rim of the revolving table is graduated in degrees, and the adjusting hand wheel on the right is equipped with a Vernier scale graduated to seconds.

As soon as the blade is in the proper position, a double-headed cutter is brought into action from below, cutting the hole.

JAPANESE soldiers have increased two inches in average height since meat was added to rice diet as part of their rations.



Golf Bags Have Special Compartment in Auto

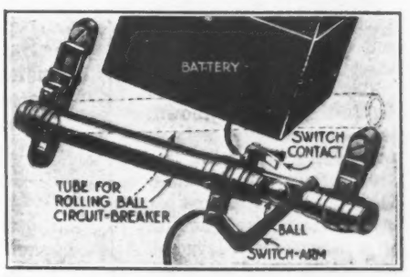
A GOLF-BAG holder made of flat steel strips like a tall iron basket, and screwed to the runningboard of the family car provides a safe and convenient place for the bag. During the week, when the machine is used solely as a town car, the holder may be removed by unscrewing two clamps that fasten the basket to the runningboard.

The basket is finished to match the color of the car. Any number of baskets may be clamped side by side on the runningboard, so that a whole foursome may travel to the game in one car, with plenty of room for the clubs and their feet.

Trip Stops Engine when Tractor Bucks

OVERTURNING tractors have always given trouble to farmers operating the smaller models, but now Yorke Young, garageman of Sequin, Washington, has perfected a tripper device that breaks the ignition circuit and stops the engine as soon as the tractor starts to buck.

The wire from the timer passes through a knife-edge switch, very lightly engaged, attached to a hollow brass pipe bolted to the engine frame. At the other end of the pipe is a heavy steel ball. When the tractor is in the proper position, the pipe slopes forward and the ball rests at the lower end. As soon as the tractor starts to rear backward, however, the ball rolls down the pipe and opens the knife-edge switch, stopping the engine and automatically preventing an upset.

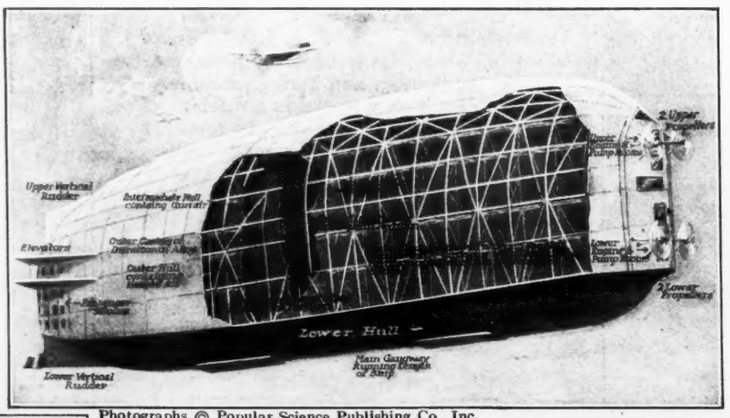


Vacuum Will Lift New Metal Airship

Air Is Ballast in Triple Hulled Dirigible Designed by Italian Expert to Combine Strength and Safety with Lifting Power

AN all-metal vacuum airship, with air as ballast! Instead of a single thin envelope of gas-filled cloth, three rigid envelopes of duralumin metal, one inside the other, and all bracing one another. Instead of inflammable hydrogen, the lifting power of a near vacuum, created by a suction pump.

Such is the new dirigible invented and designed by Signor Vaugean, a leading Italian balloon expert in an attempt to bring safety to airship travel and to remedy weaknesses that brought disaster to the *Roma* and the ZR-2.



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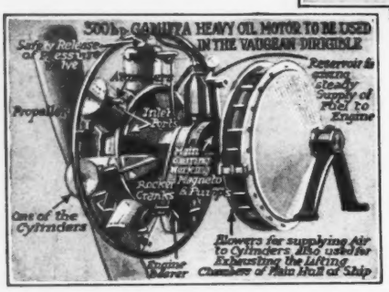
500 h.p. CANUTA HEAVY OIL MOTOR TO BE USED IN THE VAUGEAN DIRIGIBLE
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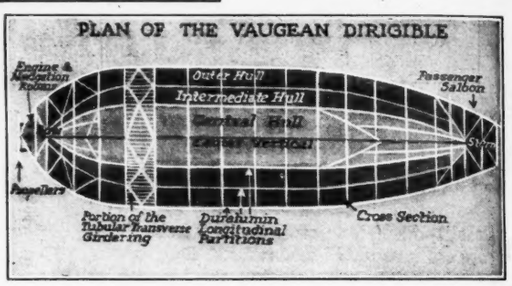
Intake Ports
Reservoir to contain Steady Supply of Fuel to Engine
Main Gearing
Rocker Arms & Pushrods
Dual Magneto
One of the Cylinders
Engine Silencer
Blowers for supplying Air to Cylinders, Also used for Exhausting the Lifting Chambers of Main Hull of Ship

Built in three sections and separated by skins of duralumin, as shown in the view above, the Vaugean vacuum airship is designed for strength and safety. Note the intricate network of girders consisting of hollow duralumin tubes filled with compressed air. The arrangement of the new dirigible is shown in the diagram at the right. At the left is the design of the Diesel type engines that propel the ship and drive the air-exhausting pumps



In principle and in design, Signor Vaugean's dirigible, which will soon be built in Italy, is a complete departure from the gas-filled ships. Explosions and fires in midair will be impossible because there will be nothing about the ship to burn or explode. Since there will be literally nothing inside the envelopes, the only way the ship can be damaged in flight is by a puncture in the outer skin.

Theoretically, the vacuum ship will not only be stronger than the gas filled ships, but will have lifting power almost as great, although built of heavier material. Thus, if successful, it will solve the knottiest problem that aeronautical engineers have had to meet—that of combining lifting capacity with the strength to assure an adequate margin of safety from collapse.

Though hydrogen is the lightest substance known, it possesses some weight, and hence has a lift less than an absolute vacuum. Of course, it is impossible to obtain a perfect vacuum in a structure as large as an airship hull, but when the pressure of the air inside is reduced to about one pound to the square inch—which is well within the power of a good air pump—the lift of this partial vacuum will be equal to that of the same volume of hydrogen.

Vacuum lift would have been generally employed long ago if inventors had been able to discover any way of making balloon walls strong enough to withstand an external pressure of 15 pounds to the square inch, and at the same time almost as light as a few thicknesses of silk. Signor Vaugean claims to have solved the difficulty by using the air to withstand air pressure!

His ship is built with three hulls, one inside the other, all made airtight by shells of thin sheets of duralumin metal. Each hull is braced and cross braced by hollow duralumin tubes filled with compressed air to give them increased strength and stiffness. These three hulls can be exhausted of air independently.

The center section is emptied of air altogether. A partial vacuum is created in the intermediate envelope, while in the outer shell the air is heated—which makes it slightly lighter than the atmosphere, but keeps it at almost the same pressure. In this way the excess of external over internal pressure upon the airship is only a few pounds to the square inch, and while a total weight of 15 pounds to the square inch must be withstood by the entire structure, every girder and plate bears its share of the load.

The triple system of envelopes, in which air becomes lighter and lighter toward the center, prevents the pressure from being concentrated wholly upon the outer envelope. Signor Vaugean declares that this system will reduce the load on any one surface of the ship to less than five pounds to the square inch, thus permitting the use of such thin sheets of duralumin that the all metal ship would have a high ceiling.

To still further reduce the pressures, Signor Vaugean employs progressive rarefaction of the hull interiors. At the ground level, where the atmosphere is comparatively heavy, only a little air is pumped out—just enough to allow the ship to rise. As the ship moves upward, the air in the envelopes is rarefied more and more, until the flying level is reached at 10,000 feet. Here the pressure is about half that at the earth's surface, and the danger of

A New Hope on the Heels of Disaster

AMERICA, appalled by the recent disaster to the airship *Roma*, and the earlier ZR-2 wreck, and all but dismayed in its efforts to develop the lighter than air craft as a commercial carrier, will watch with keen interest and encouragement the construction of the vacuum airship invented by Signor Vaugean, Italian balloon expert.

The principle and design on which this new passenger airliner is to be built, as described in the accompanying article, bring hope that the danger of collapse and the horror of fire in the air may finally be eliminated.

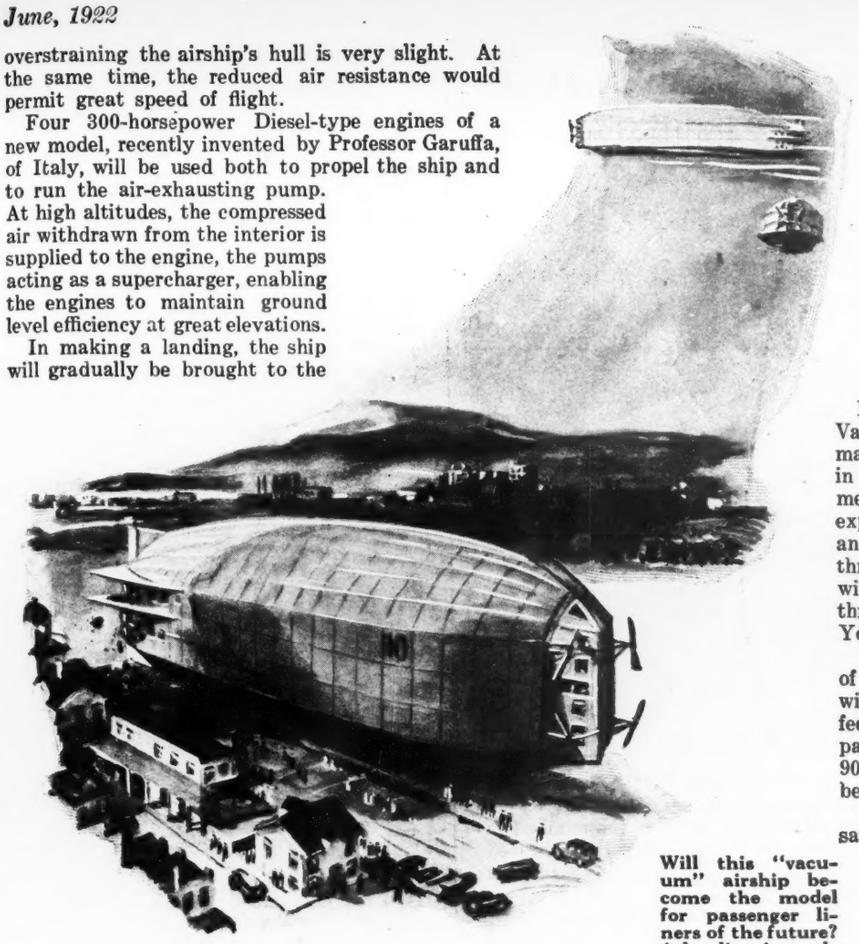
Safety demands adequate strength of materials and construction, while commercial considerations call for the greatest possible lifting power to make the airship a profitable investment. Unfortunately, every pound put into material and construction for the sake of safety diminishes the lifting power of the airship by that much. The recent disasters seem to have demonstrated that primarily they were caused by an injudicious sacrifice of strength to lifting capacity.

Theoretically, the Italian inventor's new vacuum airship promises freedom from fire hazard as well as greatly increased strength of construction without sacrificing lifting power. If this promise is fulfilled, a revolutionary advance will have been made in aerial transportation.

overstraining the airship's hull is very slight. At the same time, the reduced air resistance would permit great speed of flight.

Four 300-horsepower Diesel-type engines of a new model, recently invented by Professor Garuffa, of Italy, will be used both to propel the ship and to run the air-exhausting pump. At high altitudes, the compressed air withdrawn from the interior is supplied to the engine, the pumps acting as a supercharger, enabling the engines to maintain ground level efficiency at great elevations.

In making a landing, the ship will gradually be brought to the ground by admitting air to the intermediate and central chambers. The ship will sink, instead of being forced down by the action of the propellers and planes, for the ability to compress or rarefy the air in the hull at will, gives the airship captain complete control over the effective lift of his ship.



Will this "vacuum" airship become the model for passenger liners of the future? A landing is made by admitting air. When the ship reaches the ground, all valves are opened and the flat-bottomed craft is anchored by its own weight

Once on the ground, all valves will be opened and the air admitted, so that the ship will be held securely in its berth by its own weight, without needing a mooring mast or a hangar. The airship is flat bottomed and can be landed on any level ground.

Tremendous Speed Possible

It is apparent that the success of Signor Vaugean's design depends upon exceptional workmanship, for the slightest leaking joint anywhere in the hull would cause great trouble. If such mechanical faults can be eliminated, however, experts believe that the novel form of the hull, and the ship's ability to fly at a height two or three times that possible for the usual airship, will give it a speed of 215 miles an hour. At this rate passengers might travel from New York to London in 15 hours.

With passengers, crew, and fuel for a flight of 18 hours the total load will be 50 tons, or with air ballast 54 tons. The ship will be 393 feet long, 108 feet wide, and 108 feet high. The passenger saloon, placed aft, will accommodate 90 passengers, while the crew, numbering 23, will be carried forward.

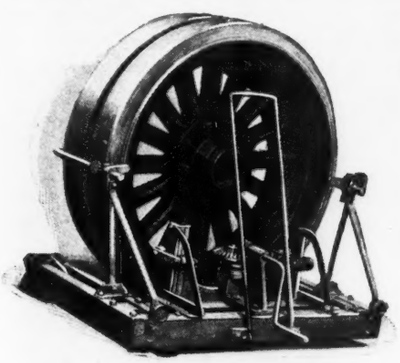
Only the weight involved by the very necessary strength appears to offer any serious drawback to the practical success of the ship.

Even should the first Vaugean airship prove unsuccessful, the experiment is one that has aroused the keenest interest among all the leading experts in aeronautics, and it is possible that it will serve as a model for the successful development of lighter than air craft.

One Man and Dolly Can Handle Biggest Wheel

ONE man can safely handle the largest auto truck wheel by means of a newly designed dolly that has a lifting capacity of one ton, and that picks up a wheel from the bottom instead of from the top.

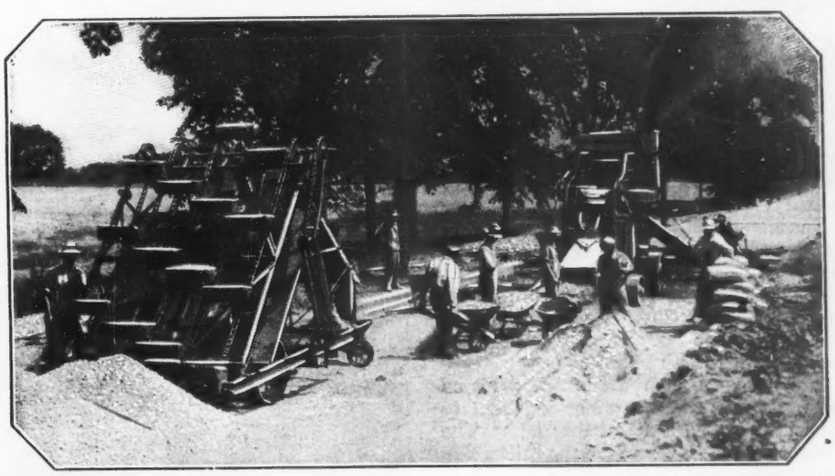
After the truck has been jacked up, the projecting forks of the dolly are lowered until they pass under the wheel. The crank handle is then turned until the wheel rests on the forks. The dolly with its load is then slipped out.



With one-ton lifting capacity, the dolly raises the truck wheel

If the wheel is to be moved, the hooks are adjusted on the inner rim, and the hand nuts tightened. The advantages of this method is that it leaves the top of the wheel free, so that a chain may be used to raise the wheel to a tire press.

Bucket Loader Now Does the Shoveling



SHOVELS are almost unnecessary tools for the contractor who makes use of a new industrial loader that employs the bucket principle in filling wheelbarrows or wagons with crushed stone or other loose material.

The machine is designed primarily for roadbuilding and concrete construction work, and consists of a sloping framework eight feet wide, up which travel four bucket conveyors. These pick up the material and drop it into bins, from which it is distributed by gravity.

Double capacity from the concrete mixer wherever the new machine is in use, is claimed by its inventors.

A gasoline engine runs the conveyors at any desired speed, and also moves the loader itself along the road fast enough to keep pace with the other equipment. One man controls the loader, and the adjustments include a method of raising or lowering the elevator buckets to conform to any unevenness in the ground.

YOU'LL understand your radio outfit a lot better after reading Armstrong Perry's entertaining articles in this and the July issue.

Streamlines New? Train Had 'Em in 1900!

STREAMLINED fuselages and wing struts—the latest word in aeronautical design—are largely responsible for increased flying speed; but how many airmen know that officials of a prominent Eastern railroad constructed and tested a streamlined train more than 20 years ago?

The locomotive was not altered for the experiment, but the cars of the train were built with curved, sloping roofs and with sides as smooth and flush as possible. The rear of the train ended in a tapered point, while the sides were carried down as close to the roadbed as feasible, for the engineers fully realized how important it was to avoid air eddies beneath the train.

The streamlined coaches' better speed, the saving in time and fuel, were not sufficient to warrant rebuilding all the passenger coaches and so the plan was abandoned, to be revived again for airplanes and autos 20 years later.

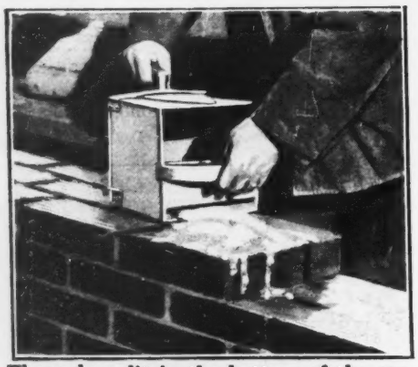
Will Bricklayers Discard Time-Honored Trowel?

AT last, after 7000 years, there are signs of a revolution in bricklaying methods.

A fountain trowel with which one man can prepare a course for 18 bricks in the time formerly required to lay three, is being tested by Major Frank Gilbreth, of Montclair, N. J., apostle of the "one best way" in industry.

The trowel consists of a light sheet-metal container filled with about two thirds cubic foot of mortar. A hand grip is provided at one end, and the old-fashioned mason's trowel is slipped through a metal loop at the other end so that the mason can wield the instrument with both hands.

The mortar is poured through a slit on the bottom of the container adjusted to the width of the course being laid. The amount of mortar spread on the bricks also can be controlled by the mason.



Through a slit in the bottom of the container pours the right amount of mortar

Trucks Dump Loads from Dock into Scow

A DUMPING dock with a projecting apron of reenforced concrete, built at Detroit, Mich., allows motor trucks to dump their loads directly into the center of river scows beneath.

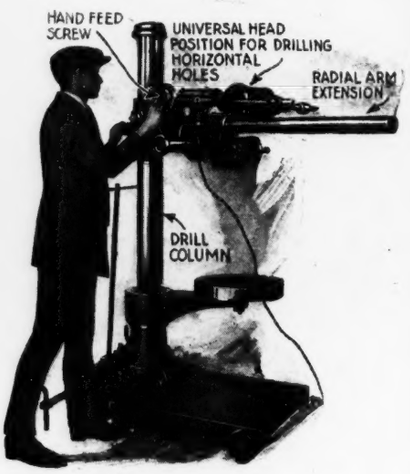
Dumping is quicker, and there is no need to trim the load on the scows, as the earth piled in the center spreads out to the gunwales by gravity, more evenly than it could be shoveled. The control of the load is said to be more certain than is possible where loading chutes are used.

The city fathers expect the dock to pay for itself within a year.

Portable Radial Drill Arm Rides on Hand Truck

A NEW portable "radial" that will hold any pneumatic or electric drill for work at any angle, consists of a substantial column and radial arm mounted on a hand-truck. The arm is equipped with a swivel head that can be set at any angle or any position around a complete circle.

The extreme height of the column is five feet six inches, and the length of the arm four feet six inches. The diameter of the drill table is 18 inches. The weight of the entire machine is 900 pounds, but ball-bearing wheels on the hand trucks enable one man to push it about the shop without difficulty.

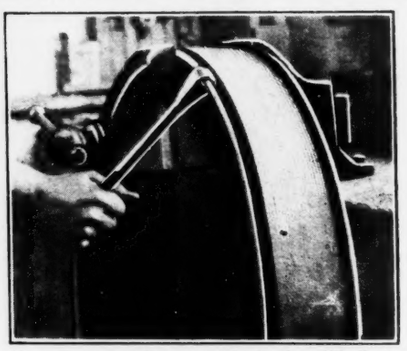


How the portable column and radial arm hold a drill for work at any angle

When in use, the rolling platform is held firmly by braking plungers thrust down upon the floor by movement of the hand bars used for drawing the machine. For exceedingly heavy work, additional bearing surface is given by two crank-shaped bolts that may be screwed to the floor.

Hand Tool Irons Out Dents in Automobile Rims

A SIMPLE hand tool for straightening automobile rims removes the dents without breaking or damaging the rim. The device is a powerful wrench that straightens the dents by applying a steady pressure. Such pressure is far less likely to break the metal than the use of a hammer, and gives the operator better control over the work.



Steady wrench pressure is less likely to damage the metal rim than a hammer

The leverage is so great that the operation is not difficult.

GLASS used in making milk-bottles is tinted pink to give milk a rich appearance.

Do Neighbors Use Your Phone? Try This Bank

IF your neighbors persist in making toll calls on your private telephone—and forget to pay—tie a bank to the receiver as a reminder. They will probably take the hint and drop in the proper coin.

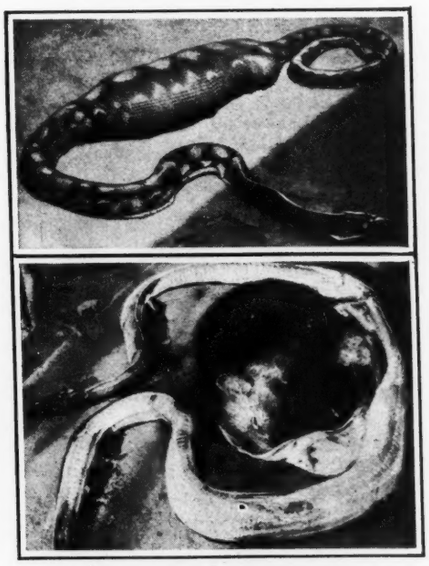
This suggestion has proved to be successful in avoiding embarrassing situations. A person calling on a private wire usually

Tied to the phone, the bank is a reminder

would like to pay for the call, and the owner of the phone usually feels he is entitled to the money. But because the phone is a private one, the former hesitates to offer money for its use, and out of neighborly courtesy the latter hesitates to receive cash in payment.

The bank is a silent reminder that the use of the phone is a business transaction, not a social courtesy.

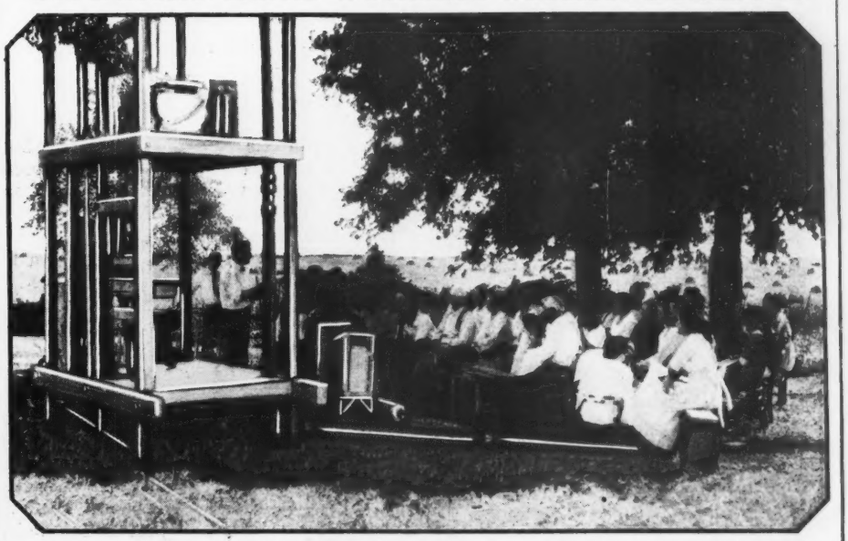
Python Kills Itself by Its Own Gluttony



DISABLED by its own gluttony, a gigantic python that had swallowed a half-grown hog was killed recently in the French Congo as it lay helpless in the sun. The power of distention in the snake's jaws and body were sufficient to allow it to swallow the pig, but the meal, once down, was so heavy, the snake could no longer drag itself over the ground.

Before swallowing the pig, the python wrapped its coils round and round the animal's body, breaking the bones by its terrific power of constriction.

Roadside Bath Teaches Home Comfort



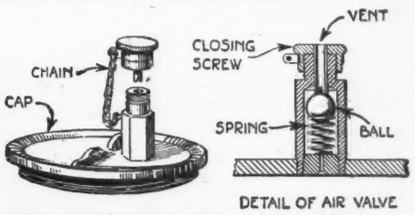
BECAUSE only one farmhouse in seven is equipped with modern plumbing, even in the prosperous sections of the Middle West, the University of Missouri is now sending out a two-ton truck on which is demonstrated complete kitchen and bathroom equipment. The demonstration, given at any point along the road where a group of farmers can be assembled, reveals how easy it is to pipe in hot and cold running water and provide a drainpipe to lead it out.

The truck carries complete plumbing arrangements with scaffolding built so that the rooms can be shown, fully equipped, on two floors.

Air Valve to the Rescue when Gas Runs Low

BY the use of a little air valve inserted in the gas-tank filler cap, the small car can now ramble right along on the last drop of gasoline in its tank, according to Dr. J. A. Baer, of Honesdale, Pa., the inventor.

Many a small car has been stalled on a hill because the amount of gas in the tank



DETAIL OF AIR VALVE

Left: The valve inserted in the filler cap. Right: Cross section of valve

was insufficient to flow by gravity to the carburetor.

By attaching a tire pump to the new valve and forcing air into the tank, the motorist can convert a gravity system into practically a force-feed system. No need of turning around and backing uphill.

THE arid deserts of Western Australia are being irrigated by artesian wells.

FOUR FAMOUS MEN

will talk to you in the July

POPULAR SCIENCE MONTHLY

Henry Ford
Glenn Curtiss
Jack Binns
Armstrong Perry

You Can't Afford to Miss Next Month's Issue

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Will Your Auto Bumper Pass This Test?

IF you want to be reasonably sure you and your motor-car will survive a crash into a telegraph pole, equip your machine with one of the bumpers tested and passed by the Chicago Underwriters' Laboratory.

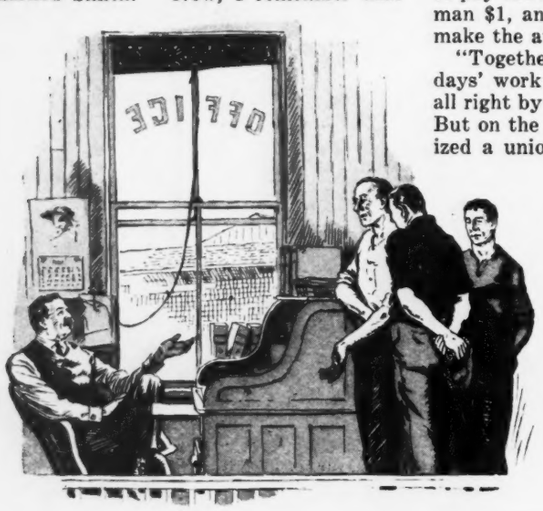
In the courtyard laboratory the bumper being tested is fastened to a strong steel framework representing the chassis, and a weight suspended from a boom high overhead is drawn back to the wall of the courtyard and released. The weight acts like a pendulum, and the force with which it strikes the bumper can be determined precisely. Observers stand near by to note the result. If a bumper can withstand the impact of a 650-pound weight swinging through a 20-foot arc, scientists figure it will come out of most road collisions undamaged.

It has been found that the point of failure is usually not in the bar of the bumper, but in the bolts with which it is attached to the chassis.

How Was This Strike Settled?

Best Answers to Sam Loyd's Brain Testers on This Page Will Win $25 in Prizes

"SOMEHOW strikes were settled with less trouble in the old days," remarked Smith. "Now, I remember that when I started my small brickyard, I engaged three men to do the work, agreeing to pay the foreman $1.10 a day, the handy man $1, and his helper 90 cents, so as to make the average wage $1 a day.



"Together they agreed to perform 303 days' work for $303, and they started off all right by each doing his first day's work. But on the second day two of them organized a union and asked for shorter hours with increased pay. Recognizing the justice of their demands, as explained by the committee, I increased the wages of two of the men so that all were satisfied. Then I apportioned the work so that at the end of the season each man received $101, and together they had performed just 303 days' work."

Who can explain how Smith managed his strike so as to have it work out as he describes?

A FIRST prize of $10 will be awarded for the best set of answers and analyses covering the three problems on this page; a second prize of $5 for the next best set; and ten prizes of $1 for the 10 next best sets.

Answers must be received not later than June 1, addressed to the Puzzle Editor, Popular Science Monthly, 225 West 39th St., New York, N. Y.

Answers to the June puzzles will appear in the July issue; the names of prize-winners in September.

Answers to February and March puzzles appear on page 110 of this issue.

Bits of Waste Cord Form 87-Pound Ball

WHAT is said to be the world's largest ball of twine shows the incredible amount of valuable material wasted by the average business. C. H. Stall of Cincinnati has made his record ball of string, already more than 2½ feet in diameter, in a few months from the twine formerly thrown away in a wholesale drug house.

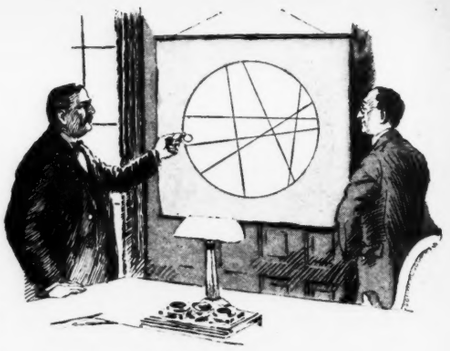
The ball now weighs 87¾ pounds, and it contains more than five miles of string. Stall is adding to the ball at the rate of several hundred feet a day. When the twine ball attains a diameter of six feet, it will be used as an exhibit in a "Thrift First" campaign.

Each Office Worker Can Have His Chair "Fitted"

A NEW adjustable office chair in which the height of the seat from the floor and the height and angle of the back may be arranged to suit the individual, has recently been designed to reduce fatigue for the worker.

The back is made low and gives support at the waist, leaving the arms and shoulders free. The chief purpose of the design is to keep the worker's shoulders back, and his lungs expanded, and the angle of the back and seat is adjusted to that end.

To eliminate fatigue, the height and back of the chair are adjustable



How Many Crossings?

IN a thickly populated region the railroad magnate planned to have his system of tracks form as many junctions as possible.

"You have done fairly well," said the magnate to his engineer, when the latter submitted the plan shown above, "for your tracks cross at 12 points; but why not do better? Make another layout and show me how you can produce the maximum number of crossing points with six straight tracks across the circle."

How many crossings will the engineer's new sketch show?

Clear the Field of Stars

HERE is an astronomical problem based on the erratic flight of Donati's comet. Commencing with the small white star, we are required to discover the shortest course through the centers of all the black stars, so as to mark them all off and end with the large white star.

In how few moves, in straight lines, could the comet destroy the 62 black stars, beginning and ending with the white stars? Of course, oblique strokes are permissible. We see how the feat is performed in 22 dashes, but that may be improved upon.

February Prize-Winners

FIRST PRIZE—Ten Dollars: H. J. Eberth, Toledo, Ohio.

SECOND PRIZE—Five Dollars: Louis Dussere, Pittsburg, Pa.

The TEN ONE-DOLLAR PRIZES: A. L. Lincoln, New York City; C. E. Moffitt, Montezuma, Iowa; John B. De Coursey, Philadelphia, Pa.; Frank F. Smith, Cumberland, Md.; Melvin Bayles, Represa, Calif.; Glen Arthur Lowery, N. Concord, Ohio; Philip S. Fogg, Palo Alto, Calif.; Hector F. Beaupré, Montreal, Que.; J. R. Rollman, Encampment, Wyo.; Theodore M. Edison, Cambridge, Mass.

March Prize-Winners

FIRST PRIZE, Ten Dollars: Warren E. Shreffler, Milwaukee, Wis.

SECOND PRIZE, Five Dollars: Ira P. Denning, Oakes, N. D.

The TEN ONE-DOLLAR PRIZES: Herbert Wottrich, Brooklyn, N. Y.; H. L. McCollum, E. Liberty, Pa.; F. W. Fetterman, San Bernardino, Calif.; A. Milton Runyon, Plainfield, N. J.; R. S. Brain, Detroit, Mich.; J. H. Coman, Durham, N. C.; Henry B. Kline, Rochester, N. Y.; Thomas Evans, New Haven, Conn.; A. C. Shenefelt, Pitcairn, Pa.; A. W. Leek, Flushing, Long Island.

Air Traffic Cop Now Aims Flashlight Accurately

A POWERFUL hand flashlight with telescope sight is the latest device to aid the traffic policemen of the air to keep in touch with planes approaching the Croydon air station near London.

The operator stands upon an open platform on a tower rising high above all the other buildings at the airdrome. In guiding the aircraft at night or in a fog he must flash a beam of light upon the plane and yet avoid blinding the pilot's eyes. This is the service performed by the telescope sight, which practically converts the searchlight into a gun.

Cross hairs in the telescope sight show exactly where the searchlight is hitting the airplane

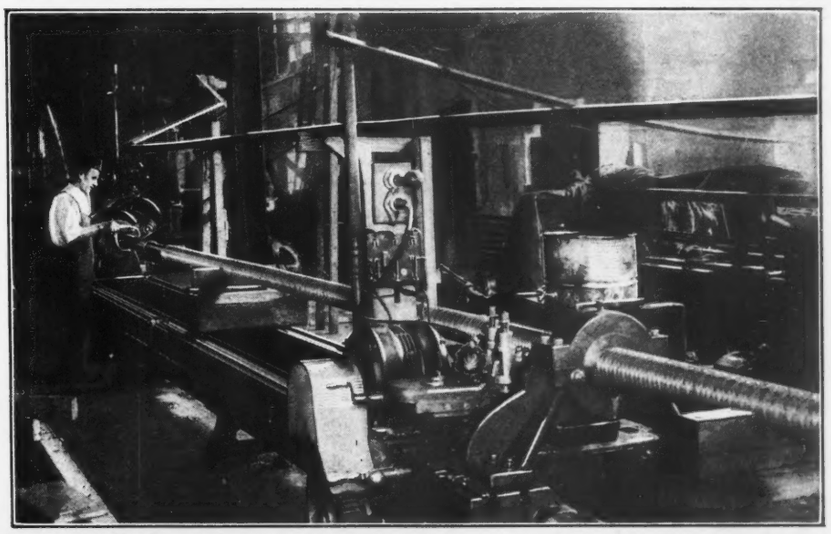
The cross hairs in the sight show exactly where the light is being focused on the plane, and it is easy to keep it on the wings, and away from the cockpit as the pilot glides along the beam to the landing field.

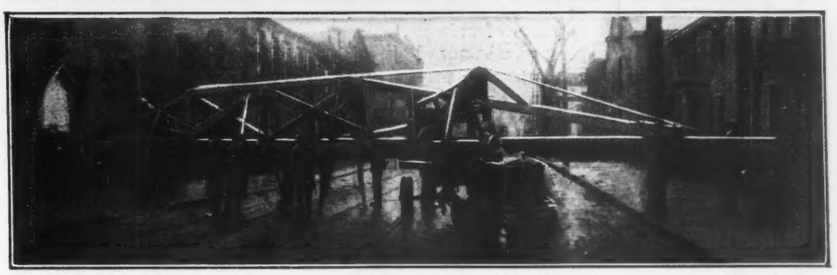
Numerous Small Potatoes Form Four-Foot "Spud"

WHILE Dixie is the land of the sweet potato, the record for the largest sweet potato ever grown now goes to California. Owned by Marie Moffett, of Los Angeles, the giant among tubers is four feet long, and weighs eight pounds.

The record potato is really a number of potatoes that grew together. Instead of producing a total of eight or nine, the hill yielded only one. For this reason it is probable that if the giant potato were planted, next year's harvest would produce potatoes no larger than the average.

Sections Welded into a 72-Foot Screw



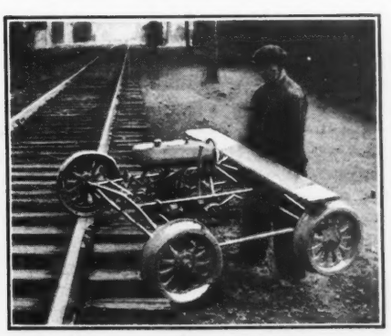


Held on V blocks, sections were welded into the long bar shown above. The lower photograph shows how the bar was delivered in a truss-shaped crate

HOW essential welding has become to the modern machinist was demonstrated in the manufacture of the longest screw ever machined—a bar 74 feet long and 4⅝ inches in diameter, required for the rifling mechanism of a 16-inch naval gun. Because bars as long as this are not forged, a line of short sections was assembled and held in V blocks until the pieces were welded together by the thermite method.

Shipping the bar proved to be a serious problem. The bar was very flexible, and would have been sprung or bent if any portion had been left unsupported. Placed inside a covering of four-by-four timbers, a trussed shipping crate, built like a small railroad bridge, was constructed around it. Three flatcars were required for the rail shipment.

In making the actual delivery, the truss was mounted on two-wheeled trucks and towed by a small continuous tread tractor. A second tractor followed, acting as a brake on descending grades.



This Railroad Motorcycle Is Safe for Inspector

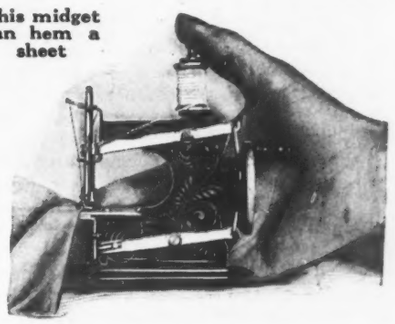
BUILT for inspection service, so light that one man can readily handle it, a railroad motorcycle has just been perfected in response to a demand for a safe one-man car. The power plant is the same as that of a motorcycle, except that the gearshift is operated by a lever instead of a pedal.

This feature was adopted for safety. It enables the operator to sit at one side of, instead of astride, the motor. Thus, if the car should suddenly round a bend and meet a train, the driver could instantly slide off.

Miniature Sewing Machine Has Fifty Parts

HEMMING a sheet with a sewing machine small enough to be held in the palm of the hand is a demonstration of the practicability of a little mechanism that sells in England for 80 cents. The number of working parts has been reduced to 50, and in spite of its small size the machine uses standard needles.

This midget can hem a sheet



When in use, it is clamped to a table. The sewer guides the cloth with one hand, while with the other she turns the small hand wheel operating the mechanism.

How Radio Adds to the Joys of My Vacation

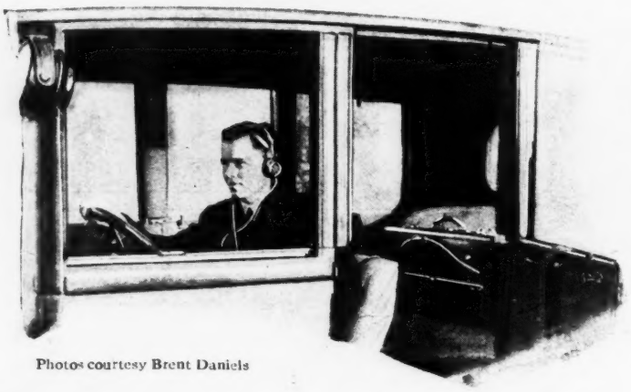
Old-Time Camper Pictures a Wireless Receiver as Your Most Companionable Chum on Motor Trips and Around Campfire

By Armstrong Perry

On an auto tour, camping trip, or merely a day's picnic this summer, a wireless receiver will bring you endless entertainment. In the following article, a veteran camper and radio man tells how to make the most of your vacation radio outfit. His helpful tips come from his own wide experience

MANY a tourist, old camper, or tenderfoot, is going to take with him on his vacation this year, as I am, the most entrancingly mysterious, continuously companionable vacation chum that ever shared the front seat of the auto, the campfire, or the straw mat on the front porch of the summer cottage—namely, the radio receiver.

For several years I have taken radio equipment with me on auto trips and camping expeditions. Sometimes, if I am going to be but a short distance from a government station, my outfit consists of only a crystal detector, a pair of phones, a hundred feet of copper wire and an iron peg. Wherever I stop the car for lunch, or settle down for a day or longer, I make a loop in the end of the wire and tie a stout cord into the loop. I take the other end of the cord and climb a tree or clamber to the top of a cliff near by. Unless there is some one to pay out the wire as I climb, I put a stick through the coil and hang it up horizontally so that the wire will unwind without tangling as I pull.



Photos courtesy Brent Daniels

From a suitcase of ordinary size on the rear seat of the car came messages and music picked from the sky

Brent Daniels, of Washington, D. C., and his "talking suitcase" ready for campfire duty

When I reach the highest point I can attain, I attach the cord. I make sure that it is long enough so that the end of the suspended wire will clear all branches and other objects, for the radio currents have a way of leaking off into anything that touches the antenna. In wet weather, to prevent the current from running up the cord and down the tree like a squirrel, I oil the cord where it joins the wire. Oil and electricity do not mix any better than oil and water.

A New Use for Your Fishpole

The other end of the wire I attach to another tree in a similar manner, leaving enough dangling to reach the ground. Sometimes I bring the wire straight down from the first tree to the tent or auto, which lessens the amount of energy picked up from passing radio waves, but often works satisfactorily nevertheless.

In a flat country where there are neither trees nor rocks, one of those long, jointed fishpoles will elevate the antenna wire at one end, while the auto top holds up the other. Or two poles can be used. Three guys of stout cord attached to stakes driven into the ground will hold such a pole in position in spite of the weight of the wire or a wind of ordinary velocity.

The antenna installed, I attach my receiving apparatus. If only detector and phones are used, I attach antenna wire and one phone cord tip to one binding post of the detector. To the other binding post I attach the other phone cord tip and a short piece of wire, which I lead to the iron spike that I have driven into the ground, or to the engine or other heavy metal part of the car. The spike in the ground is better if the earth is moist. If the soil is very dry, a ground connection on the engine is better. If the ground wire is fastened to the iron spike and the spike dropped into a pool or stream of water, the best results are obtained

Such a crude outfit brings to my ears music and voices from powerful radio-telephone stations if they are in the center of a town—only four or five miles distant—on whose outskirts I am camping. It picks up dot-and-dash messages from government and commercial stations 100 miles or more away. It brings in the weather reports, which are of even greater importance when I am living out of doors than they are at home. Also it brings in the daily news *via* the ear instead of the eye.

Once, knowing the code, I heard a battleship calling a cruiser and I listened with bated breath for secret messages which it would be treason to reveal. One came:

"Say bo, got anything on ice over there? Dryasell over here."

The same antenna and ground wire work equally well with more highly developed receivers. By taking along an ordinary loose coupler such as many beginners use, or any type of crystal detector set that includes a tuner, I extend both my receiving distance and my ability to hear different transmitting stations. And when I take a regenerative receiver, which costs more, but is 10 times as efficient, I sometimes hear European stations and can always hear all types of American radio-telegraph and radio telephone stations within a wide radius. The regenerative set or any other set using vacuum tubes, can be carried without inconvenience, even in a small car. Its tubes must be lighted by a current from a storage battery, except in a very recent type, which uses dry batteries for lighting the tube. The vacuum tube can be connected as easily as the car lamps.

The technical terms need not scare the radio novice. The dealer calls the radio storage battery the A battery, and the radio dry battery the B battery. The receiving set has on its face plain letters showing where and how to connect the antenna, ground wire, phones, and wires from the batteries. Any one can make these connections after the dealer has given brief explanations either verbally or in print.

When I get too old and too fat to climb trees, the vacuum tube set will be the only one to use, for it needs no high wires. A few turns of insulated wire around a wooden frame three feet square will answer every purpose except very long-distance reception. Once I heard a station in France working when I was listening in at Washington, D. C., with such an antenna, but I had an amplifier that was more powerful than any one would be likely to carry on a vacation.

Loop Antennae Are Easily Carried

These "loop antennas" lie flat on the auto top when not in use and stand upright when working. By turning one on its axis the user can bring in what he wants to hear with maximum loudness, and eliminate or at least reduce most of the noise that would interfere.

The things that some of the little portable outfits do are miraculous, even when explainable. A youthful inventor in Washington took me out for a trip in his car. He had with him a suitcase of ordinary size. Way out in the country he put a pair of phones on my head. Out of the sky came my own name, followed by a musical selection which I was assured by the speaker was being played for my especial delectation.

"Where's your antenna?" I gasped.

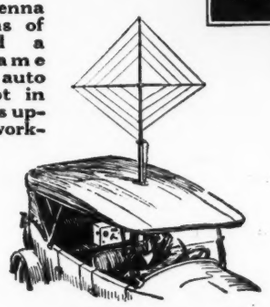
"Inside," he answered.

He opened the case. There were half a dozen turns of wire around the inside. There was no ground connection. Half a dozen vacuum tubes were glowing faintly.

Taking off the phones I discovered that the bag itself was talking right out loud through a hole in the side that proved to be the mouth of a small horn. Knowing a little about vacuum tubes, I began figuring. By rough calculation this apparatus, weighing less than the case that housed it, was multiplying the energy it grabbed from the ether by 10,000,000! Later, my young friend showed me what his receiver would do with a regular antenna and a full-sized loudspeaker. It could be heard all over a 10-acre lot.

A physician from the same city was driving around the country in his car during such days of relaxation as a heavy practice left him. I found that he knew about as much of what was going on while he was on the road as he did while he was in his office. The answer was, of course, radio. Not seeing any antenna on the machine, I inquired where he concealed it. It was sewed into the lining of the top.

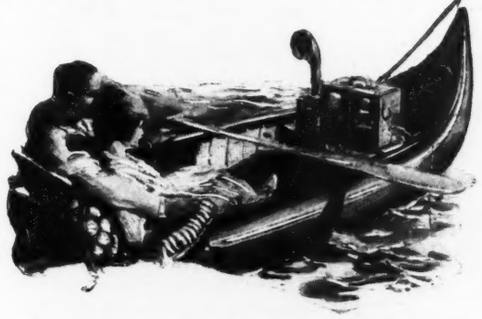
Not long ago I saw a vacationist who was not satisfied merely to listen; he wanted to talk back. So he had erected masts at the front and rear of his car, as tall as they could be without raking the bridges under which he drove. These were equipped with regular antenna spreaders holding four wires. As a good ground connection is essential in transmitting, a wire from the sending apparatus was attached to the engine of the car.



The loop antenna—a few turns of wire around a wooden frame lies flat on the auto top when not in use and stands upright when working

But the vacation radio set that deserves the ace medal comes to you in an easy-to-carry case, with an additional little bundle. You take it out to the camp, using the receiver in the car on the way. After putting the canoe over, you cut the strings on the bundle. Out rolls a square of cloth and a few sticks. Any one who was a boy before he grew up remembers instantly how to put it together. It is a tailless kite.

When you get the thing together, you discover that the string is a light copper wire. You fasten it to the bridle, give the kite a toss and up she goes. Before it reels out all the wire, you check its upward flight, take a turn around the brace in the bow of the canoe, open the case and attach the end of the wire to a binding post marked "A." You connect the batteries, drop a ground wire into the water, put on the phones, and the things you hear! There is a compact little transmitter in one side of the case and you can say things yourself if you want to—and have a license.



Drawn over a moonlit lake by a silken kite on a wire string, they listen to music playing in the distant city

"At every stop I climb high in a tree and attach a stout cord suspending 100 feet of copper wire. The other end of the wire I attach to another tree in a similar manner, leaving enough dangling to reach the ground"

The most entrancingly mysterious, continuously companionable vacation chum that ever shared a campfire is the radio receiver

A cautious electrical company has issued a solemn warning against the use of metal kite strings, because of the fact that several small boys have been electrocuted by flying their wires against high tension transmission lines.

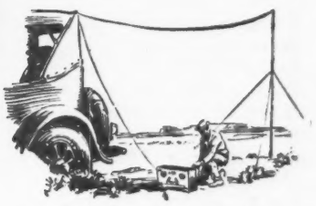
A world famous technical radio amateur let out an interesting little secret during the radio conference called by the Secretary of Commerce. The secret is that a single-circuit receiver using a vacuum tube operates also as a sending device. By putting a microphone (such as is found in the ordinary telephone transmitter) in series with the ground wire, the receiver is changed to a radiotelephone transmitter which may be heard over distances up to 30 miles. If a telegraph key is installed in place of the microphone, dots and dashes may be transmitted for even greater distances.

Receivers of this type are emitting radio waves all the time they are receiving. The microphone or the key merely controls the emitted waves in such a way as to produce signals.

Now the present law says that no radio transmitter shall be operated without a license, but that receivers may be used without a license. Single-circuit vacuum tube receivers are being produced in large numbers, in response to the enormous demand for apparatus that is simple and easy to operate. Most of those who use them are ignorant of the fact that they are transmitting as well as receiving. Just what is their legal status?

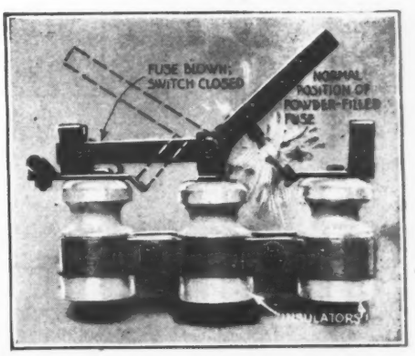
If the automobile tourist or camper, having equipped himself with a single-circuit receiver or any other that would transmit as well as receive, should slip a microphone into his hip pocket, he would have something that might be of use in an emergency. And if his signals did not carry beyond the borders of his state nor interfere with the reception of signals coming from another state, he might not have any trouble with the radio authorities.

The better way, of course, would be to secure an amateur license.



In flat country, a stout, jointed fish-pole will elevate the antenna wire at one end, while the auto top will hold the other

Powder Operates Fuse in Circuit Breaker



SMOKELESS powder, instead of the usual fusible metal link in an electric circuit breaker, is used in a new invention installed on high tension power lines of the West. The use of powder makes the fuse repeat—that is, it opens the circuit for a second, then closes it again, which is important in lines through remote places.

When there is a temporary short circuit, heat produced in a small resistance wire at the fuse ignites the charge. When the explosion destroys the tube and breaks the circuit, a swinging knife blade switch drops and closes it again. As a rule the electric surge that blows the switch also burns away the foreign substance causing the short circuit. If the short is more serious, the same action is repeated in two other similar switches, which usually clears the line.

How to Make the Most of a Gipsy Motor Trip

You Can Profit This Summer by These Helpful Suggestions from Prize Winners in POPULAR SCIENCE MONTHLY'S Contest

By Browning Robinson
Glenellyn, Ill.
First Prize

ONE family of three, one touring car, 17 days, 1130 miles. Debit: $58.97; credit: fun, rest, sport, health, and revived courage. We caught fish, made photos, swam, and tramped. We returned good as new and here's how:

Four hundred miles north of our Illinois home lie the wide spaces, merry lakes, pines, and cooling breezes of Wisconsin—ideal for gipsy motorists, as we discovered long ago.

A Handy Road Map

We cut the 35-cent state road map into pages about four by six inches, pasting them on muslin with three-eighth-inch spaces between, so that they could be studied with ease.

Our tent was waterproofed, 7½ by 10 feet ground area, seven feet high. A tape ridge ended in loops to which we attached ropes for swinging the tent between trees, or on crotched saplings. This saves poles and weight. No storm ever disturbed us. Tent, with sod cloth sewed in, rolls into a 13-pound package. We carried oak pegs to save time.

The canvas floor cloth spread over leaves supported our beds, each consisting of one quilt and one blanket. Cots that soak up cold were discarded.

Meals were prepared on a grate supported by three folding iron sides. A reflector oven faced the flames or nestled against the closed side. We baked pastry, bread, and meats, just as at home. All cooking utensils nested inside the largest kettle with a canvas cover.

The commissary was a wooden box fitting on the runningboard, held by two bolts with wingnuts. Its cover clamps down watertight on strips cut from an old inner tube. We lunched from it by the roadside or carried it to the fireside in camp.

Every Wisconsin road was numbered on the map and there were numerous guideposts. Twenty-two miles an hour proved the best cruising speed. Toward evening we usually located in some grove near water, pitched camp, swam, ate, and turned in for dreamless sleep. An hour for breakfast and packing saw us traveling again after contributing 50 cents to the farmer (if anything).

Our permanent camps in the north were in pine groves, moonlighted, and on various lakes and rivers.

Radio Set Completes the Trailer Camp

ALL the joys of a wireless telephone outfit on the gipsy motor tour, as described by Armstrong Perry in his entertaining article on page 68, were experienced by Mr. and Mrs. Thomas H. Baskerville and their mother, of Rahway, N. J., during their long camping tour last summer—a trip interestingly recounted by Mrs. Baskerville in a letter to *Popular Science Monthly*.

In the photograph above, Mrs. Baskerville is shown standing outside their bungalow trailer, "listening in" for the news from the outside world. How much real enjoyment the campers received from an inexpensive crystal detector radio set, with a four-wire antenna strung above the top of the trailer, is described by Mrs. Baskerville in her letter:

"Our wireless telephone outfit enabled us to hear the news of the day, baseball and football scores, weather reports and evening concerts, sent out by several big transmitting stations and amateurs."

Of the expenses of the trip, she adds: "Buying from the farmers makes the living reasonable. At a hotel, dinner for three would be $6; two rooms and bath, from $12 to $15; breakfast, $2.

"In the bungalow, with sizzling bacon and eggs for breakfast, a cold lunch, and a full dinner, the cost is only a fraction of the hotel charges. In fact, the cost of one night at a hotel will pay the entire expenses of our little home for a week."

More Gipsies with New Ideas

THE following readers deserve special commendation for their interesting contributions in POPULAR SCIENCE MONTHLY'S "Gipsy Motorist" contest:

MRS. ANNA BRONNE, North Woodbury, Conn.
F. D. CRITES, Richland Center, Wis.
C. D. DAVIS, 63d and Oxford Sts., Philadelphia, Pa.
ELIZABETH UMHOLTZ, 310 Lee St., Bristol, Va.
ANNA C. HOPTON, 311 Summit Ave., Syracuse, N. Y.
JESSIE WARD, 1116 S. Sixth St., La Crosse, Wis.
MRS. MAXINE G. HENSHAW, 50 Dresden St., Springfield, Mass.
GEORGE E. PAYSON, Alexandria, Indiana.
JOSEPHINE L. BRIMMER, Cazenovia, N. Y.
ROBERTA F. DIXON, 412 W. 129th St., New York
SUSAN S. ALBURTIS, Chevy Chase, Md.
W. S. VOSBURGH,, 1580 Madison St., Oakland, Calif.
ROY E. DAVIS, 230 W. Williams St., Delaware, Ohio.
JESSIE B. MILFORD, Box 273, Toms River, N. J.
EDWIN SMITH, Whitby, Ontario, Canada.
MARY H. DAVIS, 230 W. Williams St., Delaware, Ohio.

Helpful excerpts from letters contributed by several of these readers will be found on page 108.

By Edward E. Heermance
Hudson, N. Y.
Second Prize

ON half a dozen auto camping trips I have used a five-passenger touring car, carrying three or four passengers. The cost of my last trip, 1442 miles, was $96.24 for four passengers.

I use oversize tires, as I find that the tires supplied with a car are overloaded with four passengers and camp equipment.

My single pole tent measures nine by 12, and is usually attached to the car, but can be erected elsewhere. The tent has a floor cloth sewed in, which keeps out insects and makes the tent warmer.

To Waterproof Tent

I waterproof the tent by dipping it in a mixture of one pound of paraffin dissolved in six quarts of gasoline.

For cooking purposes I use a two-burner gasoline campstove. The fuel is easy to obtain and the cooking utensils are kept clean. The campfire blackens cooking utensils so that a lot of work has to be done before they can be packed.

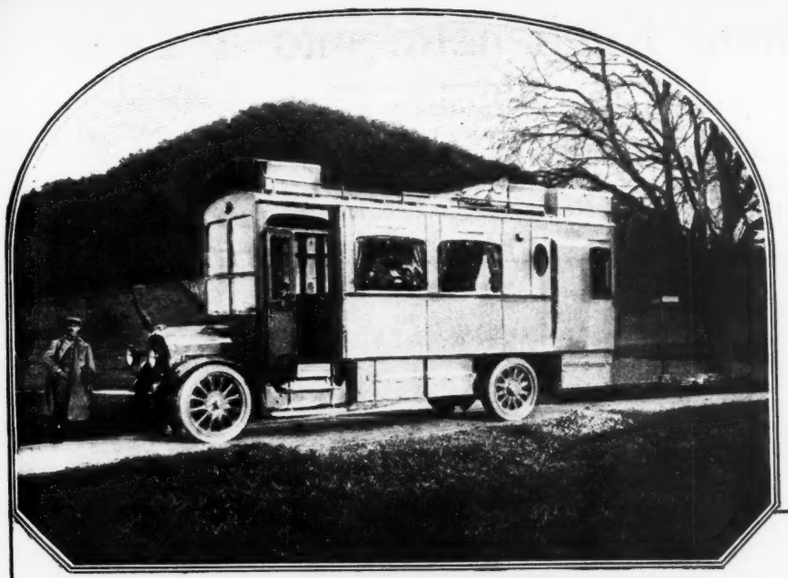
My camp equipment is carried principally in two boxes the same length as runningboards of car, a couple of inches wider and as high as will allow the doors to open. The boxes are held on the runningboards with two stove bolts, and they carry all cots, blankets, tent pegs, etc. Tools are carried in a toolbox mounted on a board clipped to the brackets of a channel-bar bumper in front of radiator. The campstove, two suitcases, and food boxes are carried in the tonneau.

I have army ponchos for raincoats and also as part of the bedding. They button readily into a sleeping bag and with a heavy woolen blanket are usually sufficient covering for summer nights in the Adirondacks. I also carry extra lighter cotton blankets for cooler weather. In using cots, it is necessary to have as much bedding underneath as over one, so the blankets are folded lengthwise and we sleep in the middle. A sweater answers for a pillow.

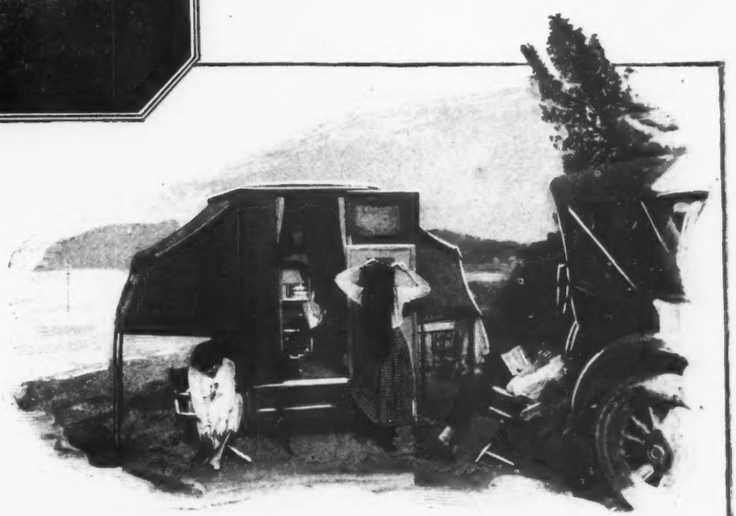
In the past three years we have toured the Adirondacks, the Green Mountains, the White Mountains, part of Maine, and a part of Pennsylvania.

Home Comforts on Wheels in Modern Motor Caravan

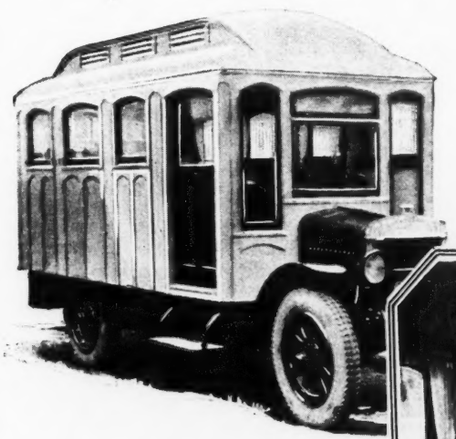
"TOURING bungalows," mounted on automobile chasses and combining all home conveniences with the delights of adventure on the road, are increasingly popular with summer vacationists. Read, in the Home Workshop, page 77, detailed instructions telling how you can transform your own car into a modern motor caravan.



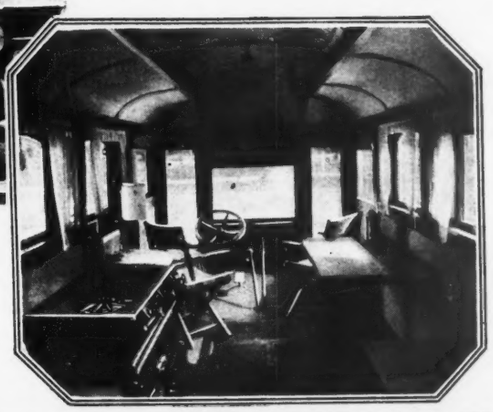
Luxury is added to traveling comfort in the motorized home pictured above. Here the family and guests may pass the hours in a richly furnished drawing-room with beveled plate-glass windows, or may view the scenery from an observation compartment in the rear



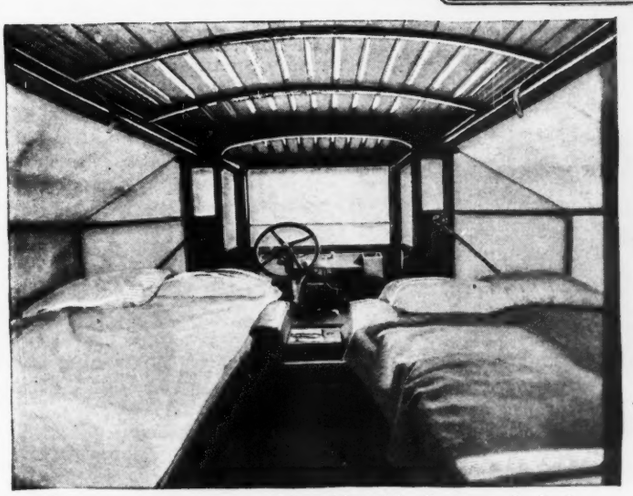
Remarkably compact, yet completely equipped, the above camp-on-wheels, now on the market, can be attached as a trailer behind your automobile. The camp may be folded up in a few minutes



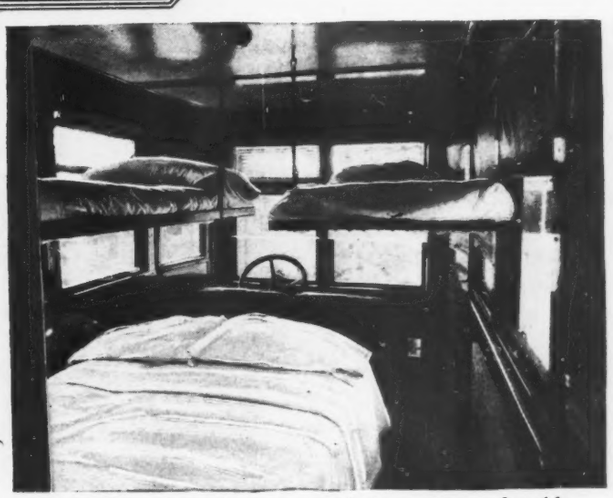
Designed on the lines of a Pullman sleeper, this substantial car makes an ideal permanent traveling home, outfitted for the longest tours. At the right is a view of the interior



While the noonday meal is being prepared over the gasoline stove just behind him, the driver is cheered by appetizing odors of roast chicken as he guides his caravan over the highways



This spacious room, with wide aisle between beds is mounted on a Ford chassis. These bodies, ready for application, have recently been placed on the market



For additional sleeping accommodations, two comfortable upper berths are hung from the caravan roof, to which they are tightly strapped in the daytime

Fold Your Apartment Kitchenette into a Table

A COMPLETE kitchenette, folded compactly into an attractive table, as shown below, saves pantry space in the ever dwindling apartment. The table top swings back on hinges and rests on brackets. One side is swung down also, to give convenient access to electric grill, toaster, and cooker, dishes and cooking utensils.

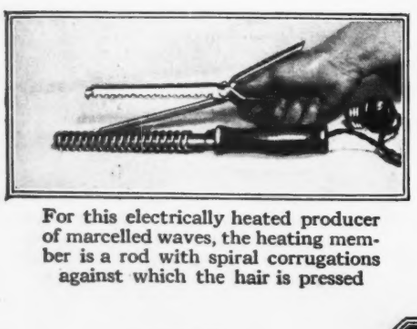
By turning the dials of this counting device, fastened to the telephone base with a bracket, the number of calls is recorded

Pressing the sides of the cover seals the jelly glass airtight without paraffining; pressing on the center of the lid makes its removal possible

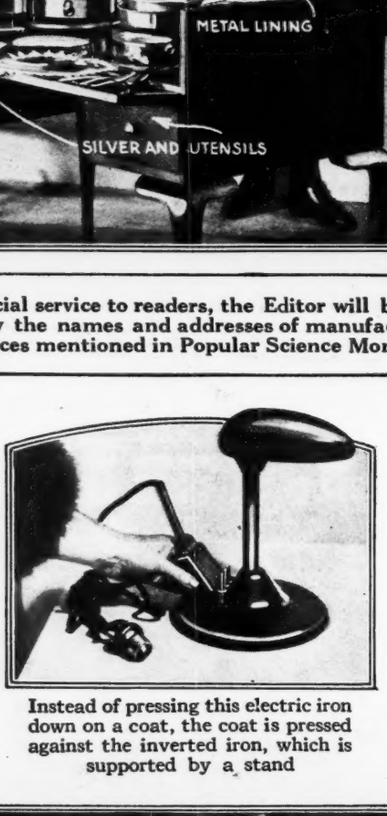
This cup, useful in the sickroom for heating liquids, contains an electric heating element the temperature of which is controlled by a switch

In this nutmeg grater the nutmeg is fastened to the crank handle, which, when turned, rubs the nut against the grating surface

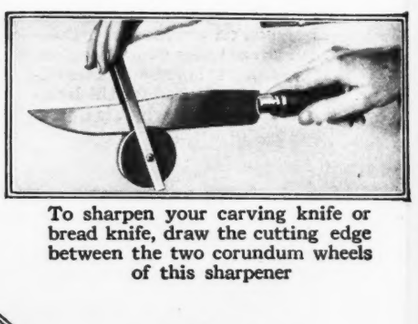
As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly



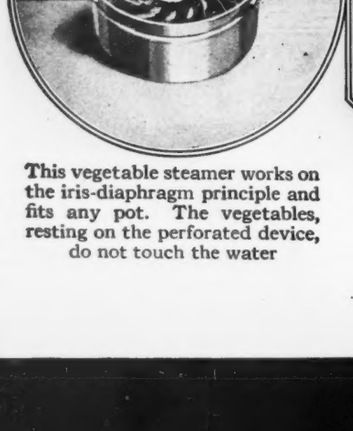
For this electrically heated producer of marcelled waves, the heating member is a rod with spiral corrugations against which the hair is pressed



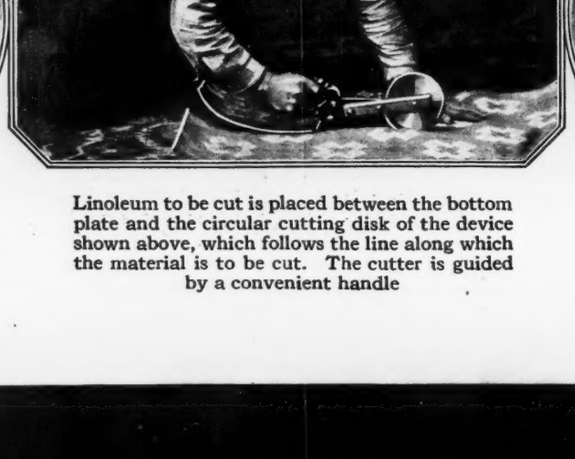
Instead of pressing this electric iron down on a coat, the coat is pressed against the inverted iron, which is supported by a stand



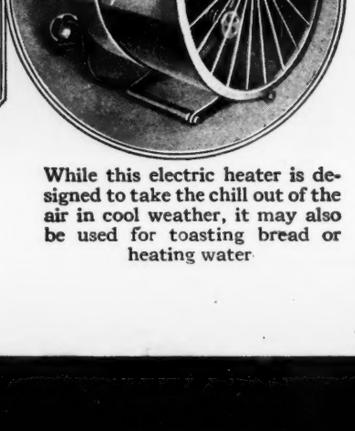
To sharpen your carving knife or bread knife, draw the cutting edge between the two corundum wheels of this sharpener



This vegetable steamer works on the iris-diaphragm principle and fits any pot. The vegetables, resting on the perforated device, do not touch the water



Linoleum to be cut is placed between the bottom plate and the circular cutting disk of the device shown above, which follows the line along which the material is to be cut. The cutter is guided by a convenient handle



While this electric heater is designed to take the chill out of the air in cool weather, it may also be used for toasting bread or heating water

Engineers Hang 500-Foot Bridge in 13 Hours!

Every Beam and Cable, Cut in Advance, Fits to the Fraction of an Inch as Long Suspension Structure Is Assembled

ERECTING in 13 working hours a 500-foot suspension bridge across the Willamette River, at Oregon City, Ore., engineers of the Oregon State Highway Bridge Service recently gave an amazing demonstration of the construction speeds now obtainable as a result of modern methods of preliminary mathematical calculation.

Every beam, cable, hanger, and plank in the entire structure was cut to the exact size and laid out on the river bank before any actual building was attempted. Because every element in the complicated structure fitted to the fraction of an inch, the building was accomplished almost as quickly as an automobile can be assembled.

A Temporary Structure

Speed in the work was necessary because an old suspension bridge, built across the Willamette in 1888, was to be taken down and replaced by a new arch viaduct, and it was necessary to build a temporary footbridge to allow hundreds of people to cross the river to their work. Traffic could not be suspended, even for a day, and it was also necessary to avoid interference with navigation on the river.

The first step in building the temporary bridge was to frame the towers. On each bank of the river six piles, each 90 feet long, were laid horizontally and bolted together. Emplacements — consisting of substantial timber footings embedded on solid rock —were prepared, and the towers, hoisted in place by a floating derrick, were braced and guyed. The instant this was accomplished, two gangs of men set to work, one gang erecting the approaches while the second swung the suspension span.

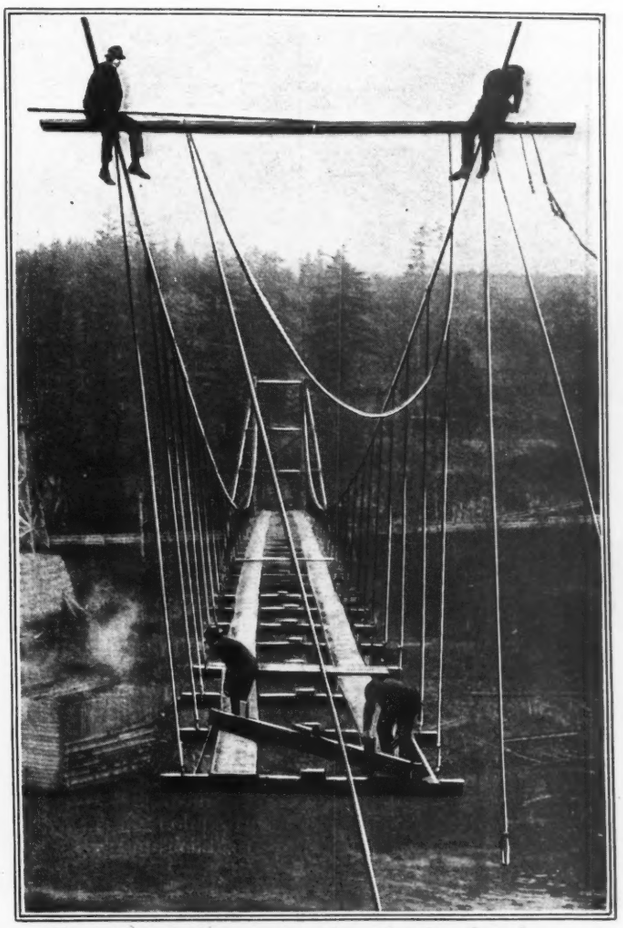
Two parallel wire cables, each composed of four one-inch ropes, were passed across the river and over the towers, then fastened to anchorages.

Two men then climbed to the top of each tower, placed a plank across the cables, and took their positions at the ends of the plank, each man straddling one of the cables. To these men were handed the hangers, or vertical ropes with which the roadway was to be hung to the cables. The hangers had already been cut to the correct length and fitted with clamps ready to attach to the cables. The workmen moved out along the bridge, fastening the hangers as they went, while a second crew of two men following, laid the framework and spiked down a temporary roadway as fast as the hangers were fixed.

In constructing the roadway, each floor beam was suspended from two opposite hangers by slipping each end into a U bolt already clamped to the lower end of each hanger. To the beams, spaced at equal distances by a space gage, four 2 by 12 inch planks were spiked lightly.

This process was repeated in suspending and planking each of the 48 floor beams, providing a temporary footway across the bridge by which material could be carried out as the construction proceeded. In the meantime the framed approaches to the bridge were being bolted into place, all the wooden truss members having been shaped previously. The crew that followed the men laying the floor beams, put down the permanent deck. As a result of this concerted effort, the bridge was opened to the public without any interruption of traffic.

The details of the construction offer an interesting example of the engineering design of a temporary structure. This bridge is not intended to remain in service more than a year—hence the extensive use of wood, especially in the towers.



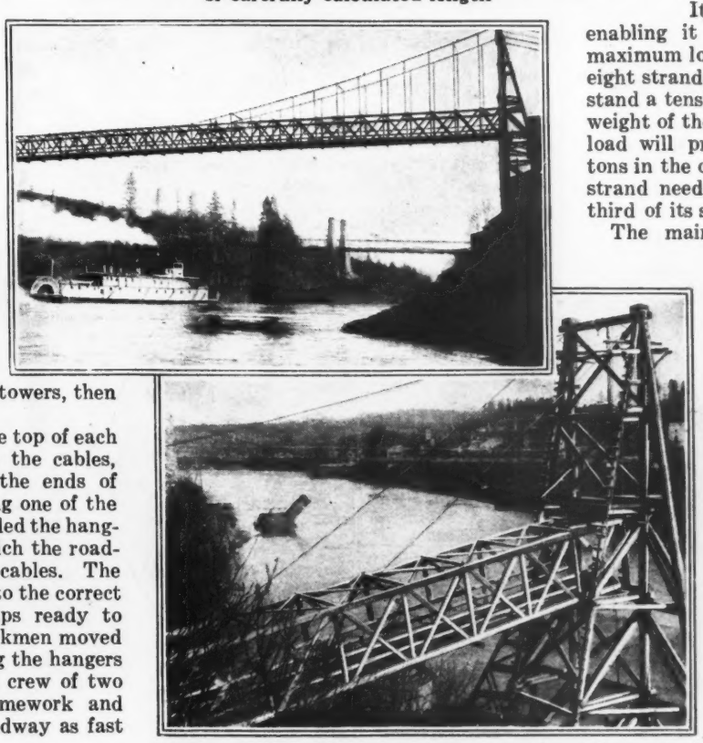
The bridge during construction, showing floor beams being suspended from the two main cables by hangers of carefully calculated length

Bridge Holds 500 Persons

The span is for pedestrian traffic only, and is planned to carry a maximum live load of 500 persons at 160 pounds each —that is, about as many people as could crowd upon the bridge. It is built with a factor of safety enabling it to support three times the maximum load. For example, each of the eight strands in the main cables will withstand a tension of 58 tons. The combined weight of the bridge and its maximum live load will produce a total tension of 160 tons in the cables. Dividing by eight, each strand need carry only 20 tons—about a third of its safe working load.

The main span is 496 feet between towers, with a navigational clearance of 75 feet at low water. Each of the 48 hangers is of six-strand flow steel cable with hemp centers. Since these must often bear heavy loads for a few seconds at a time, the factor of safety is raised to five.

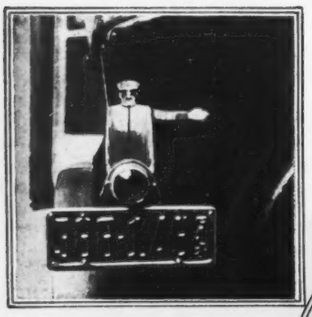
The stiffening truss is of laminated timbers, and is 10 feet wide by 10 feet high. All joints are bolted and spiked. To maintain street clearance under the approaches, the angles of approach vary from a grade of 20 per cent on one side of the river to 14 per cent on the other. While this might not be tolerated for a permanent bridge, the variance is of no consequence for this temporary structure.



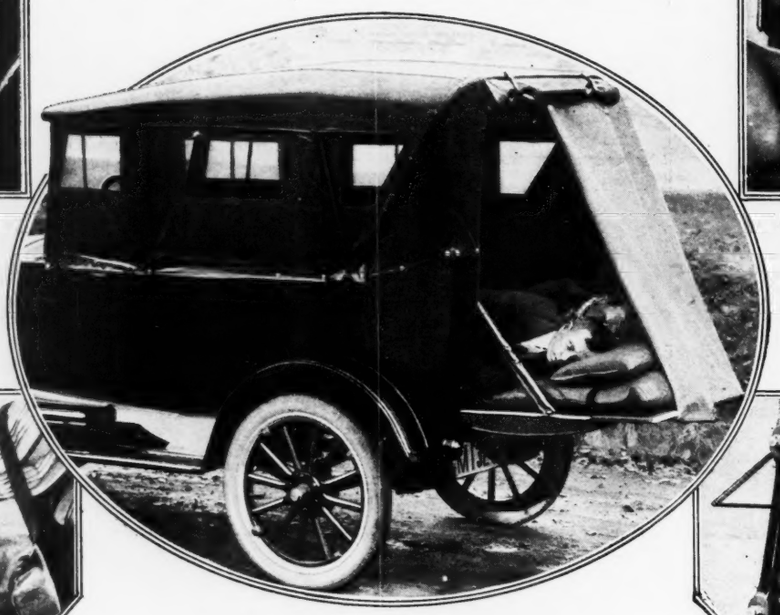
This and the other tower were framed on the ground and hoisted into position. Above is the completed bridge

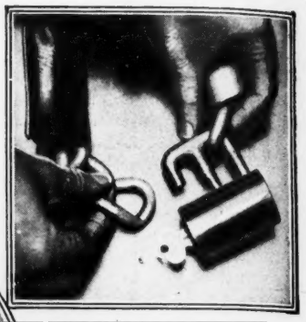
How Your Auto May Become a Roadside Bedroom

Any motor camper can reduce the bulk of his outfit by means of a convertible auto body that can be transformed into comfortable sleeping quarters for two. A door cut in the rear of the body drops to the level of the car floor, the rear seat moves forward —and you have a roomy roadside bedroom



This miniature traffic cop fastened just above the taillight raises its right or left arm to signal which way the car will turn

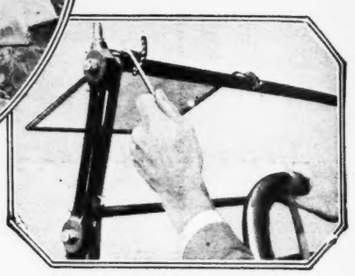




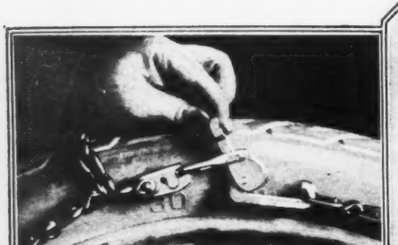
Designed to resist every method of the thief, this tire lock is made with solid body and three - point shackle of steel

Cleaning upholstery of your car is light work with this hand vacuum cleaner. The dustbag hangs from the arm

As a special service to readers, the Editor will be glad to supply the names and addresses of manufacturers of devices mentioned in Popular Science Monthly



The glare shield shown above can be adjusted quickly by means of a small lever within easy reach of the driver



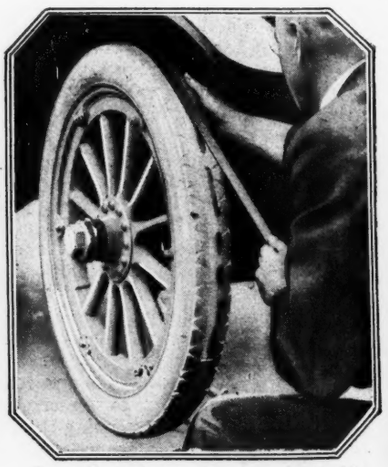
Rattling of the tire chain and unnecessary wear are prevented by this safety hook, which takes up the slack. A small lever locks chain

Touch a button and a small electric light behind the glass tube of this aluminum oil gage shines through, revealing how much oil still remains in the crankcase

This emergency gasoline can fits into the space beside the regular tank of the Ford car, and is locked by turning the spring handle

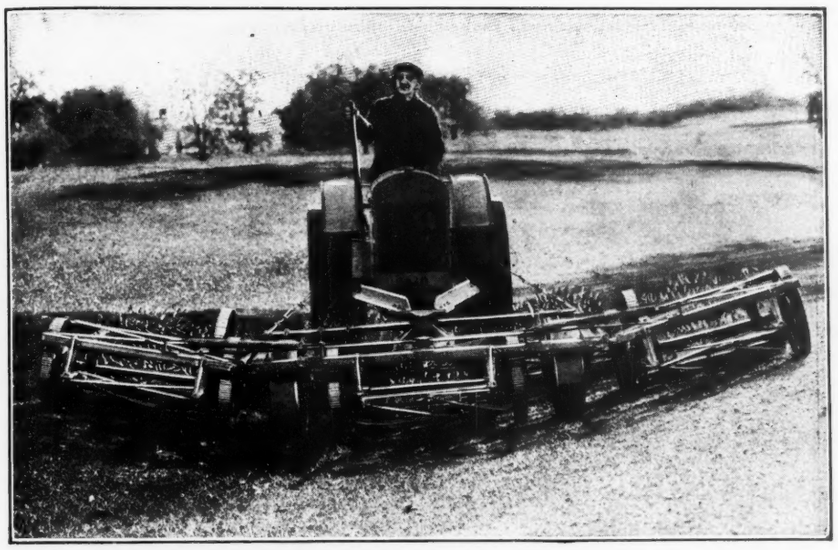
This auto lavatory for the long tour consists of a reservoir bolted to the chassis frame and a faucet that folds under the runningboard

Take the baby with you. He can ride in comfort and safety in this newly designed high chair strapped to the auto seat



Stretched about the tire and held fast by cement to the center of the tire surface, this new tread is good for 1000 miles

Five-Unit Mower Cuts Uneven Lawns



GRASS on uneven ground where the usual power lawnmower cannot operate may be mowed by a newly invented machine in which mowers are driven in units of five. Each cutting unit is independently connected with the drawbar, and, by means of an extension from the front of the tractor, is pulled instead of pushed, so that each unit is free to float over the ground without carrying the weight of the frame.

The end units will ride banks or drop down slopes at an angle of 30 degrees or more, cutting the grass perfectly. Two smaller units drawn directly behind the three forward units cut the grass in the spaces that would otherwise be left by the gaps between the units.

Airplane Gas Tanks "Crash" in Safety Tests

AIRPLANE gas tanks from all over the world are "crashing" at Aldershot, England, in attempts to win the $9000 prize offered by the British Air Ministry for a gasoline tank that will not catch fire nor leak after an airplane smashup.

Filled with gasoline, and fitted with every sort of shock absorber and lining that the ingenuity of inventors can devise, the tanks shoot down a 60-foot rail inclined at 45 degrees, attaining a velocity of 50 miles an hour. At the bottom, they are released to crash upon a solid concrete bed.

Previously, of course, the tanks have been subjected to the fire of guns loaded with incendiary bullets, armor-piercing shells, and explosive ammunition.

Traveling at 50 miles an hour, the tank crashes into concrete

Villainous Cuckoo Lays Eggs of Any Size

FOR ingenious villainy, the cuckoo holds the prize among birds. It lays its eggs in the nests of other birds, then, as soon as the young cuckoos hatch, it lifts the other nestlings on its back and throws them from the nest or robs them of the food brought back by their parents.

Why do not parent birds recognize the cuckoo egg, and refuse to rear it, since the size, color, and markings of the eggs of all birds differ? The reason is that the cuckoo seems to have the ability to lay eggs of the same size as those already in the nest, whether they are large or small. This rare power of "egg control" is possessed by a hen at Hazelwood, Ohio. This hen has laid one egg 3¼ inches in diameter, it is said, and a second only an inch long. They are pictured above.

"Third Hand" Holds Your Telephone Receiver

LIFT your telephone receiver off the hook, and a newly invented holder will pick it out of your hand and carry it higher, placing it against your ear and leaving you with both hands free to make notes while you telephone.

A Z-shaped supporting arm is clamped on the telephone upright and the shank of the

A mechanical arm lifts the receiver to your ear

receiver. As the phone is picked up, this pivots on the lower end and a stop on the lower bracket prevents it from falling after the phone is at the level of the ear. This height, and the distance between the phone and the mouthpiece, can be adjusted to suit the user. No springs or ratchets are used.

Torch Converts Cactus into Cattle Food

ROBBING cholla cactus and prickly pear of their spines with portable burners has converted a dangerous cattle menace into palatable food for live stock, and has saved the lives of thousands of steers in drought stricken areas of the Southwest.

Cactus is abundant, and once it is deprived of its thorns, cattle thrive upon the plants, which supply water as well as food when springs dry and other vegetation is killed by drought.

A cactus burner weighs less than a dozen pounds and is easily operated by one man. The outfit is strapped to his back, so that his hands are free to guide his horse or manipulate the torch. The tank holds

Distillate is forced by air pressure through a pipe to the burner

about 2½ gallons of distillate, which is forced by air pressure through a long iron pipe to the burner.

The air and oil are mixed so as to throw an intense flame for a distance of three or four feet, hot enough to burn off the dry spines almost instantly.

THE greatest recorded depth in the Pacific Ocean is 31,614 feet—near Guam.

Submarine Torch Saves Cities from Water Famine

Divers Mend Great Main with Electric Burners in 53 Feet of Water

WORKING desperately in six-hour shifts, in the murky depths of New York harbor, three divers, using a newly designed oxyelectric torch to repair a broken cast-iron water main, recently saved 110,000 residents of Staten Island from a serious water famine.

In the gloom and muck of the river bottom, where the pipe lay buried in 26 feet of mud, the divers, with steadily flaming torches, cut through 30 feet of metal from 1⅝ to 3½ inches thick, removed a broken section of pipe 12 feet long, and replaced it with a new section, relieving a serious situation in a third of the time that would have been required by sawing and cutting with pneumatic tools.

The broken main is a siphon made up of flexibly jointed 12-foot sections crossing the harbor at the Narrows between Long Island and the Borough of Richmond. It was broken by a harbor dredge that dropped its spud, or vertical anchoring pile, on or near the pipe, knocking a hole in one section.

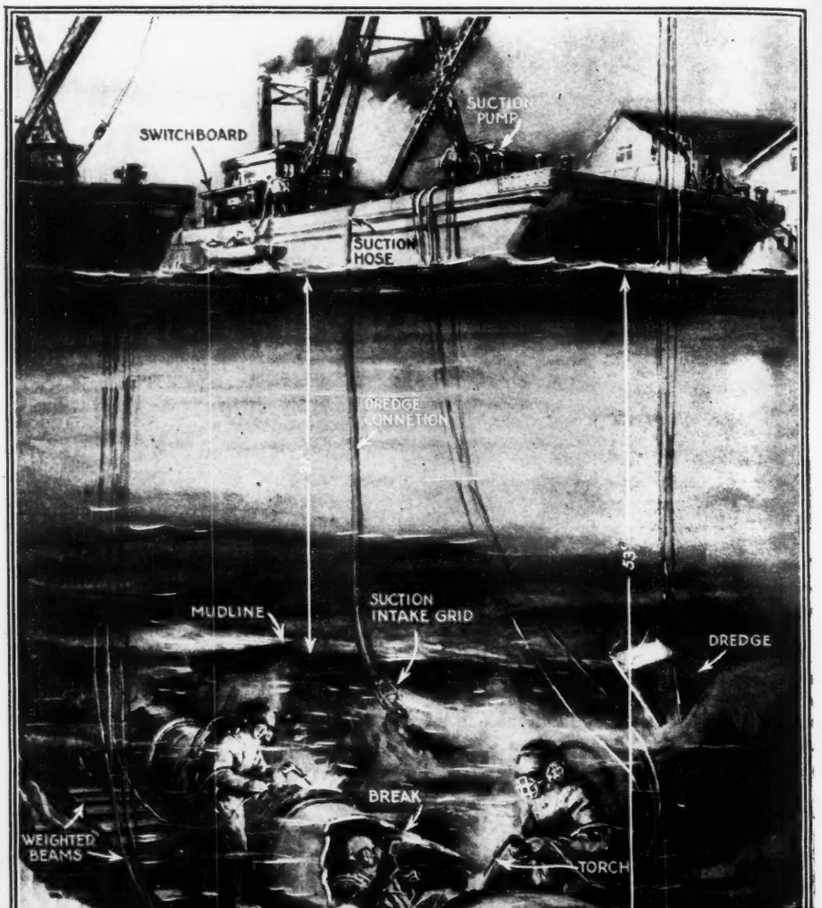
Tons of Mud Dredged Away

To permit the divers to work on the break, 26 feet of mud covering the pipe was dredged away. It was then necessary to remove the broken section under 53 feet of water, without disturbing adjoining lengths.

The divers worked simultaneously at three points. First they completely severed an adjoining pipe length. To cut the joint at the other end of the cracked section they were forced to cut away the upper sector of a bell, or flare, 3½ inches thick. Before they could reach this bell, they found it necessary to make two cuts and release an encircling wrought-iron band 1½ inches thick and four inches wide. Then to cut the lower portion of the pipe, a diver crawled inside the main, which he could enter only after the fracture had been enlarged. In the face of these difficulties, the efficiency of the new torch made it possible to complete the cutting in nine working days.

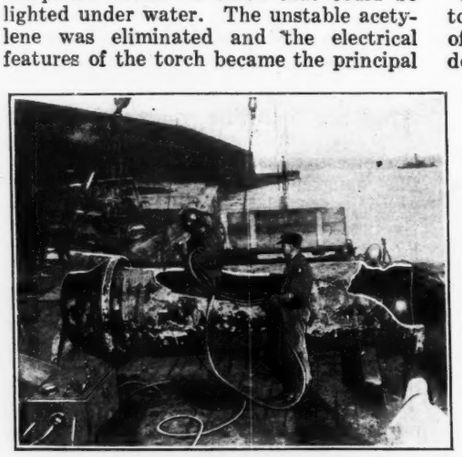
Once the cracked section was cut loose and removed, the repair was completed by lowering a new section into place, and making the joint watertight by packing it with lead wool—also a new invention. To hold the new section firmly, encircling steel collars were placed over the bell ends and drawn together by long, threaded bolts.

Cutting cast iron under water is a new achievement. W. E. Kirk and R. E. Chapman, of New York City, had worked for several years on a torch for this purpose. Their invention was inspired by underwater cutting torches invented in Germany, which, while unsuccessful, had proved that an oxyacetylene torch, when equipped with a bell-shaped shield over the burner, would burn under water if it was ignited at the surface and carried below in a position permitting expanding gases in the bell to force the water out of and away from the flame. However, if the position of the mouth of the bell allowed the water to enter, or if the pressure was not great enough to keep the water back, the torch was extinguished and it was necessary to carry it to the surface to be relighted.



With the flames of their oxyelectric torches blazing steadily in 53 feet of water, three divers swiftly cut out and removed a 12-foot section of cast-iron water main in the manner shown above

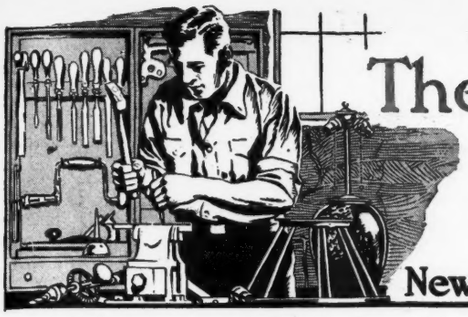
By a radical change in design, Kirk and Chapman devised a torch that could be lighted under water. The unstable acetylene was eliminated and the electrical features of the torch became the principal rather than a subsidiary part of the apparatus. In cutting, the metal is fused by an electric arc, and then cut by a blast of "cutting gas." This flame is hot enough to turn water into steam, creating a zone of vapor within which the electric arc does its work. Inside the bell there is a carbon electrode through which pass two small brass tubes that feed the cutting gas at the point of the arc. The gas is supplied from the surface by a hose, within which are the electrical connections. One wire goes to the carbon electrode and the other side of the electric current supply is connected with the work to be cut.



The broken pipe section after its removal. A diver is demonstrating the use of the electric torch for outside cuts

How the Torch Is Lighted

To light the torch, the diver simply touches the tip of the electrode to the work, then draws it back about a quarter of an inch. The arc invariably results. To stop cutting, the electrode is drawn beyond the arcing range. The temperature of the electric arc is nearly twice that of any oxyacetylene flame.



The Home Workshop

New and Useful Things for the Practical Man to Make

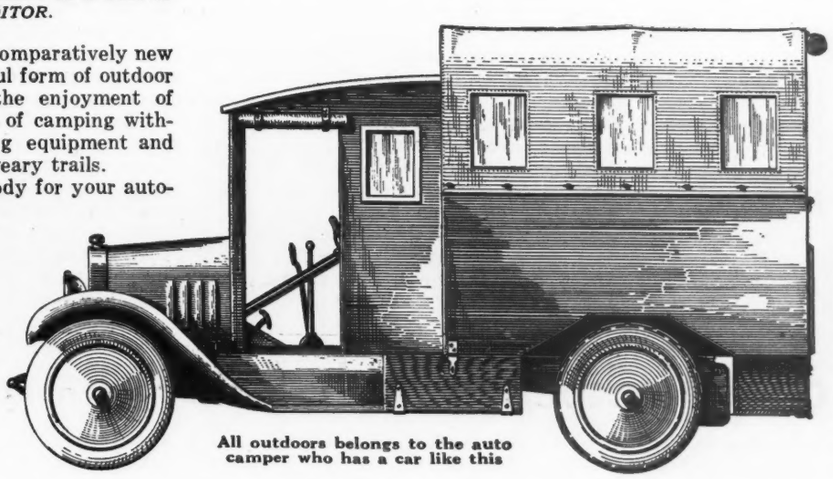
Converting Your Car for Auto Camping

By G. A. Luers

THE broad highway and the wide spaces of the country now lure the auto campers. Some of them will pile tent, blankets, mattresses, food and camp paraphernalia into their cars and set out, trusting to good luck for smiling skies and pleasant camping grounds. The wiser ones, if they have the time and means, will convert their car for auto camping by building a special body with bunks, table, lockers, stove, and some or all of the conveniences in this outfit that Mr. Luers has designed especially to help the readers of POPULAR SCIENCE MONTHLY make their own automobile camping equipment at a cost of less than $100.—THE EDITOR.

AUTO camping is a comparatively new and most delightful form of outdoor life. It permits the enjoyment of all the zest and pleasure of camping without the labor of packing equipment and supplies over long and weary trails.

To have a separate body for your automobile especially designed for auto camping is most desirable. It will prevent any possibility of the original body of the car being disfigured by rough usage, and it allows you to keep your camping equipment together in a compact way, so that whenever you desire to make an excursion there need be no tedious gathering together and stowing away of the thousand and one necessities for camping in comfort.



All outdoors belongs to the auto camper who has a car like this

The body that is illustrated has these advantages. It is installed as a separate unit after the car body has been demounted. This is possible because in practically every car the body is a unit that extends to the dash, or edge of the cowl. By the removal of the body bolts and possibly the rear fenders, the body may be detached, leaving the chassis, which contains all necessary operating parts, such as the gas tank, battery, and steering gear. By means of similar bolts the camping body is secured to the chassis frame, in which no additional bolt holes have to be drilled. A change of bodies does not require much time, especially if hoisting equipment is available to lift them.

The use of this camping body may not extend beyond two periods yearly. It can be constructed in leisure time, without interfering with the use of the car, and placed in readiness to practically the last detail, by carefully planning the work and obtaining correct measurements of the frame and the exact location of the steering gear, gearshift, brake, and other details. These measurements should be made most accurately and placed on the blank diagram below to form a basis for all the dimensions of the finished body.

Inasmuch as no two makes of cars have similar measurements, the over-all distances shown should be regarded only as approximate. They must be modified to suit the individual chassis to which the body is to be fitted. The most essential dimensions are those indicated on the blank chart.

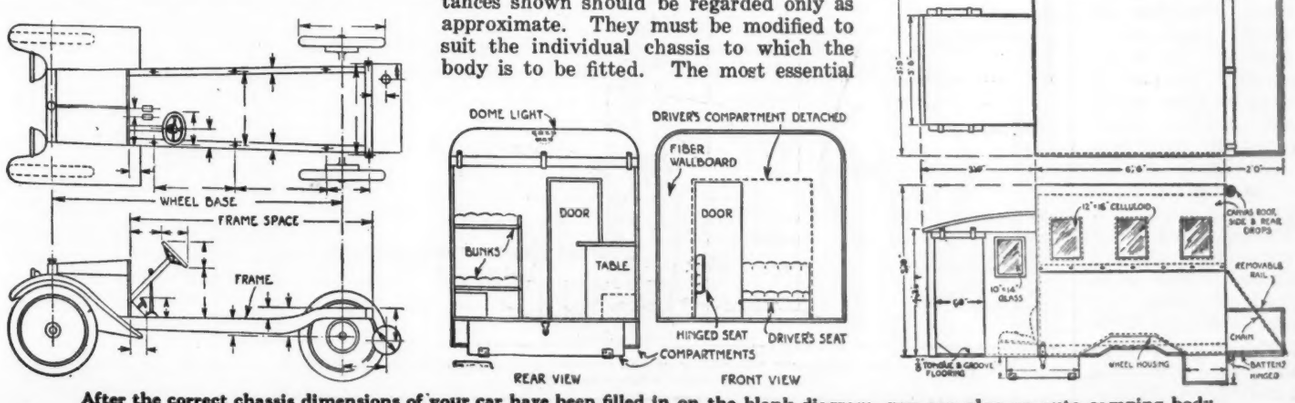
The chief material required in construction is wood. The wooden framing and flooring combine lightness with the flexibility required to withstand the twisting stresses incidental to travel over uneven roads.

The covering and side curtains should be of waterproof canvas or rubberized canvas; this will maintain a comparatively light overhead weight and prevent the outfit being top heavy. The body, sides, rear, and doors are of any good grade of tough, pliable wallboard, though ½-in. wood sheathing can be substituted. In several special bodies with which the writer has helped, the use of wallboard has proved especially satisfactory; it is adapted to rapid construction because of the conveniently large area of the sheets. When painted, this material is practically weatherproof, and the smooth, even appearance justifies its use, even if it is a little more difficult to obtain than wood.

In the arrangement of the body shown in the lower right-hand sketch, accommodations for two persons are provided. Provision for four bunks is possible by making the combined table and pantry removable so that berths may be lowered at night.

The driver's compartment is separated from the inside for convenience. It is more interesting and comfortable for the campers to occupy the seat facing forward.

Three outside lockers, two at the sides,



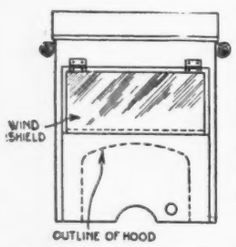
After the correct chassis dimensions of your car have been filled in on the blank diagram, you can plan an auto camping body as shown in the other drawings

forward of the wheels, and one at the rear, are essential to hold small articles, such as clothing, food supplies, fuel and oils, hunting and fishing paraphernalia. These are large and commodious and, being set low, do not tend to make the car top heavy.

Illumination is by means of a top light or dome, connected with the battery as most convenient. Lights for reading, writing, and other work are placed on the walls inside, if desired. The side coverings should permit ample ventilation for hot nights, but provide close-spaced turn-fasteners so that they can be buckled down tightly when cool weather is encountered and it is desired to heat the inside of the car by means of one of those indispensable oilstove heaters. It is an easy matter to arrange netting inside the side curtains for safeguarding against mosquitoes and other insects.

Follow Diagrams Carefully

Sufficient detail is shown in the sketches to enable the builder to determine the amounts of materials for an average car and by adding 15 per cent to this, he will be assured of more than that required, even if his car is of a somewhat longer wheel base.

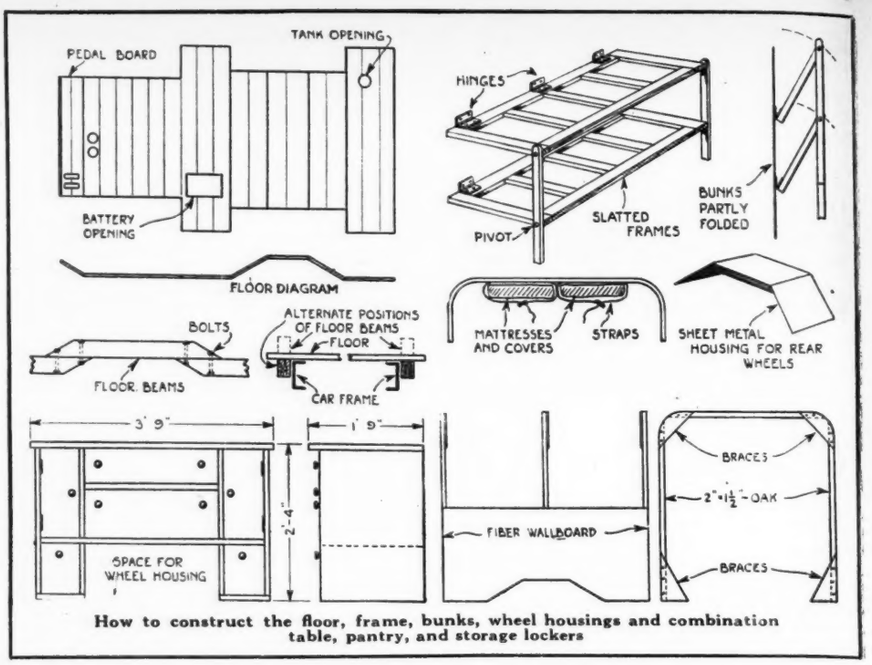


Front of driver's compartment

In the plan shown the material should cost less than $100, depending somewhat upon the fittings used. The wood, canvas, and wallboard are the least expensive items, while the hardware will prove the more costly. Where hinges, fastenings, catches, etc., are available and do not have to be purchased, the cost will be cut almost 50 per cent.

The cost for labor, if it is desired to have this body built, will be about twice that of the material, or about $200.

The main consideration in making this body, as in any other task involving construction, is that of planning. When carefully drawn up, even if the owner has only rough ideas on sketching, the work is half done. That is mainly a matter of determining the distances and measurements of the chassis and frame, the positions and dimensions around the wheels, gasoline tank, steering gear, and levers. With these definitely down on paper, the over-all dimensions of the body may be worked out; then from the over-all dimensions, each frame member, brace, floor support, and beam is cut.



How to construct the floor, frame, bunks, wheel housings and combination table, pantry, and storage lockers

Use screws in the assembling of the wooden parts where possible. As a precaution against the body's coming in contact with the rear wheels, allow fully 12 in. above the wheel with the load off the frame.

This plan can be elaborated to the extent of finishing the inside of the body to conceal the frame with canvas and upholstering and making each part of finished wood, carefully painting and staining all visible surfaces. The main consideration, however, should be to build as light a body as possible.

Finish the outside with either a dark green or olive drab paint. Black is too sober for a camping car; drab is recommended as a dependable color that does not show mud to any appreciable extent.

Fit Up Your Workbench with Lathe, Saw, and Drill

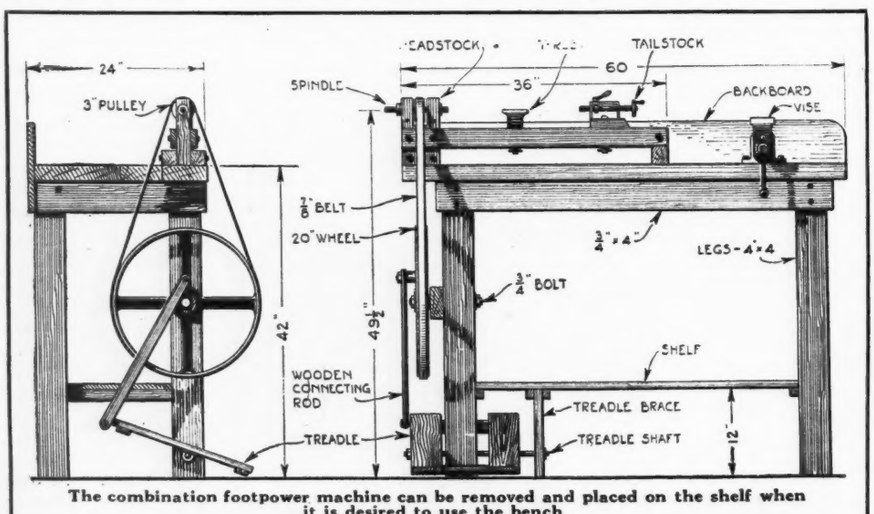
By Joe V. Romig

THE first requisite of the home workshop is a good sturdy workbench fitted with a neat and serviceable vise. Add to these a few simple tools and immediately it becomes possible to build more equipment—a small lathe for wood-turning, a grinder for sharpening tools, a drill press and other machines. Each of these individual tools, however, takes up space and, if purchased, costs considerable money. An additional outlay is also involved on account of the necessity of buying a motor. Because of the cost and since the space allotted to the home workshop is usually small, many amateur mechanics abandon the idea of using machines at all, and content themselves with hand tools.

The happy solution of the problem lies in the combination of a workbench and a lathe with detachable shears. The lathe head, of course, can also be used for other purposes, such as drilling, buffing, grinding, sanding, and sawing. The machine can be operated most conveniently and economically by a simple treadle device fastened to the left front leg of the workbench.

The lathe, as shown in the accompanying illustrations, has a swing of 5 in. in diameter and takes work up to 26 in. between centers; it will run an 8-in. saw and pull a 10-in. disk grinder. Handfeed drilling is accomplished by using a small drill chuck in the headstock spindle and a drillpad on the tail screw. The power available is ample to drill up to ⅜-in. thick steel.

The detachable shears can be dismounted from the lathe by removing the two ½-in. bolts that clamp them to the bench. When removed, they can be placed on the shelf below, out of the way, but close at hand.

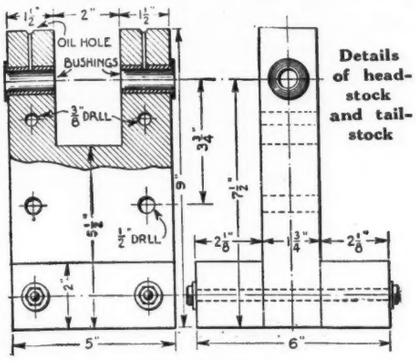


The combination footpower machine can be removed and placed on the shelf when it is desired to use the bench

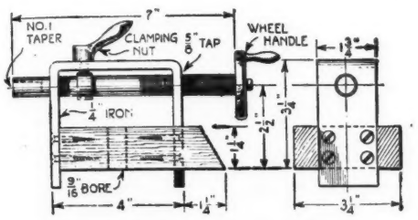
In constructing the outfit, build the workbench first, using 2-in. dressed lumber for the top, preferably oak or maple. The front board is longer than the one or two rear boards, as it carries the machine head. Good solid legs of 4 by 4 in. stock are used and an apron of ⅞-in. boards runs all around the bench top. Cross pieces are screwed to the legs to receive the shelf, which stiffens the whole structure. A wide board is also fastened to the rear of the bench to form the backboard. Use

long wood screws in place of nails to fasten the whole bench together.

The head for the machine equipment is made of hard wood, as shown. Holes are drilled through it and fitted with brass bushings, in which the spindle runs. The



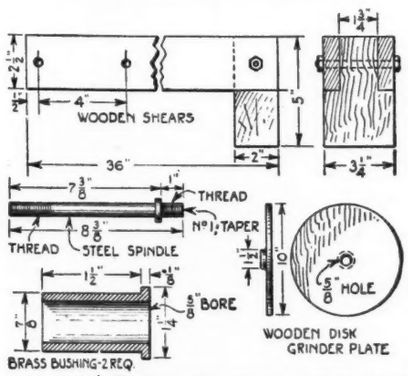
Details of headstock and tailstock

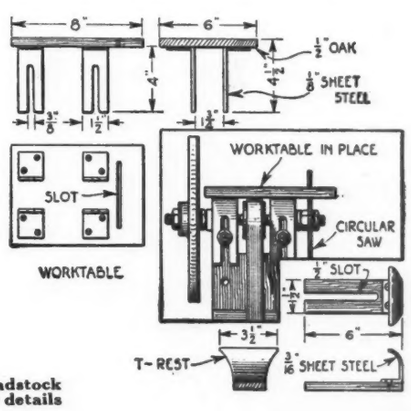


spindle, threaded at each end, is of steel. The long thread is for carrying the grinding wheels, the disk grinder, and buffing wheels, and the short front thread is for the faceplates and chucks. A 3-in. pulley is fastened with screws to the spindle between the two bearings. The base for the head is made by bolting two pieces of wood against its sides with long bolts. All the woodwork should be planed square.

The construction of the tailstock is novel and simple. A piece of flat iron is bent in the blacksmith shop to the dimensions indicated and is then fastened to the flat wooden block with wood screws. The block is mortised to receive this iron piece, and the projection of the iron between the shears at both ends keeps the tailstock in perfect alinement with the headstock at all times. A ½-in. bolt, nut, and washer are used to clamp it down on the shears.

The T-rest is made of steel and wood as shown, a slotted piece of wood being used





The wooden shears or lathe bed, headstock spindle, T-rest, worktable, and other details

for a base. This rest can be moved in and out or swung at any desired angle.

The shears are made of hard wood, carefully dressed straight and true. The pieces are ¾ by 2½ in. by 3 ft. The tail end is clamped with one ⅜-in. bolt to a rest block or short leg. The front end is slipped over the headstock and is clamped in place with through bolts ½ in. in diameter. The driving wheel in this instance is from an old washing machine. A similar wheel can be picked up in any junkyard for a few cents. The treadle is made as shown and mounted on a long bolt, which forms the treadle shaft. A two-board treadle will suffice for this machine, as the lathe is short and work can be done without difficulty as far to the right as the tailstock will go. A wooden connecting rod couples the treadle and the wheel, and a ⅞-in. leather belt drives the pulley.

The method for making the worktable to be used in connection with the saw is clearly shown in the detail drawing. The angle braces are of sheet steel screwed to the bottom of the table and have slots that slip over two ⅜-in. bolts, which run through the headstock and clamp the braces tightly to the sides of the head. For draft work on patterns, the table can be slanted to suit requirements.

A small 2 or 3 in. scroll chuck mounted on a faceplate will be found a valuable addition on many small jobs of turning up brass and fiber, polishing, and the like. Other uses will constantly be found for this exceptionally useful little home workshop combination machine.

Bench Talks

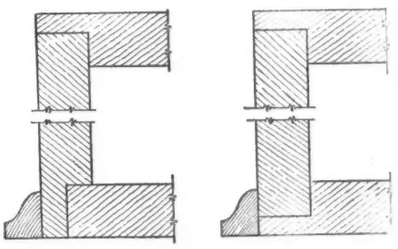
Systematic Planning Will Save You Many an Hour in Your Home Workshop

By Arthur Wakeling

IT is surprising how often the amateur mechanic—and sometimes even the professional—makes his work much harder than it should be simply because of lack of system. Frequently this is due to lack of knowledge or experience; sometimes it is a matter of carelessness and haste in planning the project thoroughly at the outset.

A few principles in the field of woodworking will show what I mean. A good foreman always will lay out parts in pairs whenever possible; for instance, the top and bottom, the front and back, and the ends will be made the same, if it can be arranged in any way. All similar joints will be made exactly alike in any particular piece of work; for example, the rabbets will be made the same width and depth, and all grooves will be made the same distance from edges as well as the same in width and depth. This saves greatly in time and labor because more pieces can be worked at one time, with one setting of tools and machines; and the parts being standardized, as it were, go together far more readily and accurately. Construction so planned, too, is usually more workmanlike and durable than that arrived at by hit-and-miss methods.

An elementary but interesting illustration of this came up in connection with the designing of the radio cabinet described in last month's POPULAR SCIENCE MONTHLY. As originally laid out, the joint between the top and ends and the bottom and ends was as shown in the sketch at the left. It was quickly seen that this would involve a waste of time, for the reason that the top and the bottom would be alike in neither size nor shape; that the ends, while alike in size, would each have the top edge square and the bottom edge rabbeted; and that the rabbets in the top and in the end would not be alike in depth. The sketch was altered as shown at the right of the illustration, thus making the top and bottom exact pairs with similar rabbets, and so simplifying the two ends.



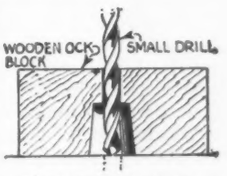
Detail showing section through case before and after revision

It might be noticed in this connection that so experienced an engineer as Mr. G. A. Luers, who wrote the article at the beginning of this month's Home Workshop, says, "The main consideration . . . as in any other task involving construction, is that of planning."

The beginner, far more than the old mechanic or craftsman, is always tempted to shirk the task of carefully laying out a piece of work before he gets involved in the problem of actual construction.

Preventing Breakage of Drills

EXCESSIVE breakage of small drills can be prevented by the use of blocks as shown by the accompanying drawing. Each block should be bored through with a bit a trifle larger in diameter than the drill that is to be used, after a larger hole has first been bored from the bottom up for a short distance to provide a place for the chips.



Block supports drill

The use of these blocks will permit the drill to make the first "bite" into the metal without springing and will speed up the work, as well as increase the life of the drills.—P. H.

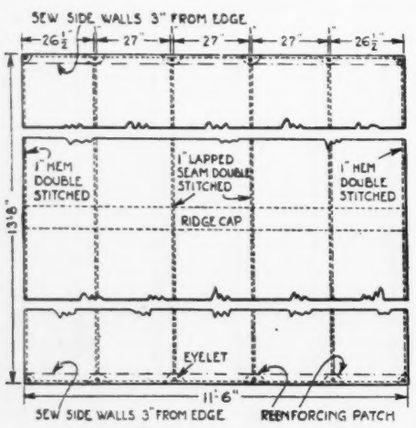
Make a Wall Tent for Your Summer Trip

By C. S. Taylor

THE points to look for in a tent are not many, but they all are very important for a comfortable and happy vacation in the woods or at the shore. The best all-around tent is the standard wall tent of the United States Government specifications. A tent of this kind is easy to set up, has a pitch sufficient to shed rain well, can be securely guyed to stand a heavy gale, and, if well made and waterproofed, will be found cool on hot days and dry in bad weather.

The most satisfactory size is dependent upon the number of persons to be sheltered. A 7 by 9 ft. wall tent will be about right for two, while the 9¼ by 11½ ft. tent illustrated is big enough for four, and is often preferred for a party of two because of its comparative spaciousness.

This tent is shown set up with a fly, although the latter is not essential; it will, however, be found a good addition. If you



How the roof section is sewed

want a fly, allow 22 yds. of material for making it. The fly may be set up over the tent to form a double roof, or, better yet, used over the front entrance to serve as an awning. Under it the cooking may be done on rainy days and in hot weather it forms a nice porch.

In choosing the material for a tent of this kind, do not make the common mistake of getting too heavy goods. Eight-ounce double twisted or filled canvas duck is about right. You can buy brown duck if you prefer that color, or dye the material after it is made up.

To make the tent, you will require 54 yds. of cotton duck. This comes in 29-in. width only. Begin by making the five sections illustrated, afterward sewing them together to form the front and back walls, the roof, and side walls. All the sewing can be done on an ordinary household sewing machine, using the heaviest thread the machine will carry, and stitching each lapped seam along each edge. This makes a strong and durable tent. For sewing the eyelets, use common string, waxed, and overcast the stitches.

An edge of 1 in. should be allowed all around the outside for making lapped seams. The front is fitted with a door flap and while the back wall may also have one, if desired, the tent is usually made with a closed rear wall. That the front flap may be closed in stormy weather, one side laps over the other a few inches. This makes all snug and tight when the tie straps are tied across the door flap. Eyelets are worked in over grommet rings as shown in detail drawings.

The call of the open spaces

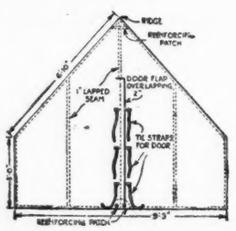
The roof section is simply a rectangular piece, with the extra reenforcement or ridge cap across the center. This is not essential, but it makes the tent stronger in its weakest point, where the ridge pole comes. The drawing shows all details and dimensions necessary. The side-wall sections are then made as shown and sewed to the front and back walls.

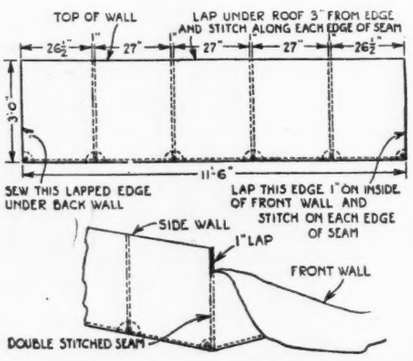
When all sections are completed, sew the front section to the roof section, lapping them so that the edges of the cloth are inside. Start at the ridge or point and end at the side walls. Sew on the back wall in the same way. The side walls are then attached in the same way, lapping all edges inside and stitching along each edge to make a strong joint.

While not strictly necessary, a sod-cloth is desirable. This is simply a strip of canvas 9 in. wide sewed to the bottom edge of the tent all around. Stores and camp supplies may be placed on the sod-cloth to hold it down and keep out insects, cold, and rain. For a tent of this size, 41 linear feet of 9-in., or 14 yds. of 29-in. canvas will be required. The inside edge should be hemmed.

To set up the tent, 50 feet of 3/16-in. manila rope will be required for guys, 12 metal slides, and 24 wooden or metal tent pegs or stakes. The stamped steel pegs are best, for they hold better and can be used over and over again; but wooden stakes can be made from any hard woods, ash or hickory being the most desirable of them.

If a brown or forest green color is wanted for the tent, buy a few packages of dye for cotton and dye the tent after it is made up and before waterproofing it.

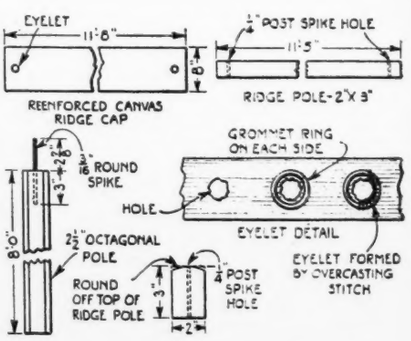




The front section and the side wall

Waterproofing preparations can be bought ready to use or you can make your own, as I have done.

To waterproof, dissolve ½ lb. alum in 4 gals. boiling rainwater. If no rainwater is obtainable, put a small handful of borax in the water. In a separate tub dissolve ½ lb. of lead acetate (sugar of lead) in 4 gals. water. Let both solutions stand until clear, then pour off the alum solution and add the sugar of lead solution to it, using a clean tub or other receptacle. Let stand a few hours and pour off the clear liquor. Then thoroughly saturate the canvas, working the cloth with the hands until it is soaked through. Squeeze out, rinse in clear water, and stretch on a line to dry. Sugar of lead is a poison, but only if taken internally. There is no danger in using the chemicals as outlined and most cloths are waterproofed by their use. The tent treated in this manner



The ridge pole and cap, tent poles, and eyelet details

will not only be waterproof, but also fireproof to a considerable extent.

To set up the tent, lay the ridge pole on the ground, with the spikes of the posts through the holes in it and hoist up the tent with the ridge attached. Now fasten the four corner guys a little to the front and set taut with the slides; then peg down the guys until all are taut and are taking the strain evenly. In damp weather the ropes will shrink and draw too tightly on the tent. They should, therefore, be eased a little when it begins to rain and tightened to take up the slack when the ropes dry out.

Paint Preserves Machinery

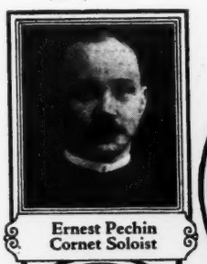
THE steel and iron of machinery of all kinds, unless otherwise protected, require painting wherever possible for purposes of preservation.

Before painting a metal surface, the greatest care should be taken to clean it well. Scrape through rust spots to the metal with scrapers or wire brushes, and give the surface a final scrubbing with dry brushes. Remove every trace of oil and grease.

Two or three coats of paint should be well brushed on. See that any cracks are filled with the pigment.

Red lead, which is believed to protect iron from rusting, is expensive and the color is often objectionable, although the addition of a small amount of lampblack will improve both the color and working qualities. The paints made of iron oxide pigments are quite satisfactory, because they combine cheapness and a high degree of durability. Any good oil paint will be serviceable if carefully applied.—H. D.

CONN RADIO CONCERTS


Ernest Pechin
Cornet Soloist

Mathew Amaturo
Saxophone Soloist

John Dolan
Cornet Soloist

Simone Mantia
Euphonium Soloist

Eugene LaBarre
Cornet Soloist

Brass Choir
San Francisco Symphony Orchestra

Pictured here are some of the artists appearing in Conn Radio Concerts. Above—Frank Westphal's Rainbow Garden Orchestra, Chicago.

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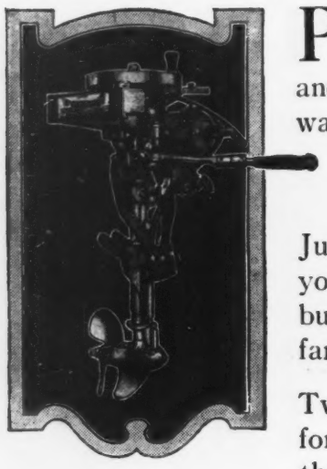

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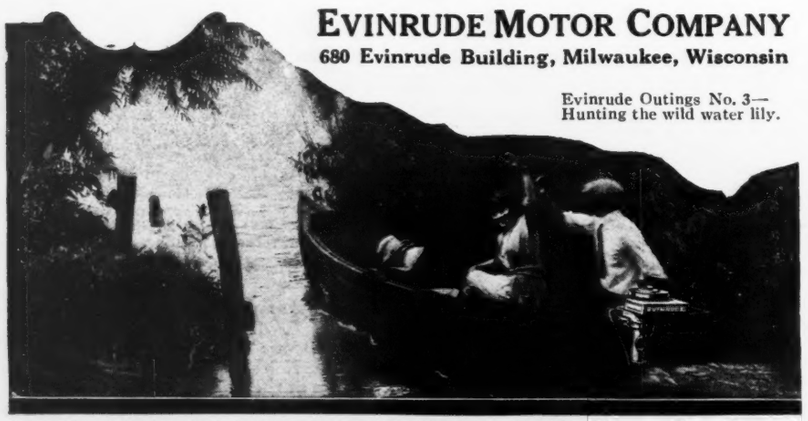

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Win a Bonus for Your "Best Ideas"

HOW many excellent ideas have you run across in your work with tools? Wouldn't some of them help the other fellow in his work? If so, why not send in your good suggestions to the Home Workshop Editor, POPULAR SCIENCE MONTHLY, and compete for the monthly "Best Idea" prizes?

The new contest begins next month and runs until September. In addition to the regular space rates, prizes of $15.00 and $10.00 will be awarded in July, August, and September, as a bonus for especially useful ideas sent in by readers. Keep the articles as short as possible and illustrate them with sketches or photographs, or both.

The June prize-winners in the contest just ended are:

FIRST PRIZE, $15: Henry S. Laraby, New Haven, Conn. (See page 86.)

SECOND PRIZE, $10: Mrs. H. A. Smith, Dexter, Ia. (See below.)

How to Make a Pullman Play Table for Children

By Mrs. H. A. Smith

(Second "Best Idea" Prize for June)

MY husband has made a piece of furniture that I am sure would be a great help to every mother of two or more children. Our little folks sit at this table by the hour and amuse themselves with the paints, pencils, scissors, and toys that are kept stored in a drawer that slides out either way beneath the table top.

The dimensions we found best are as follows, although others might be just as

Small children will play contentedly by the hour at this table

suitable: Length 40 or 42 in.; width 26 in.; table top, 17 by 26 in.; height, table and seat backs, 25 in.; height of seats, 11 in.

The table and seats are connected at the bottom by a 1 by 4 in. board along each side. The whole is movable and is narrow enough to go through any ordinary doorway. The children therefore can use it in any room or on the porch, as desired.

SOFT steel arbors do not ruck up when driven into cast iron or steel work if both arbor and hole are previously smeared with dry lead.

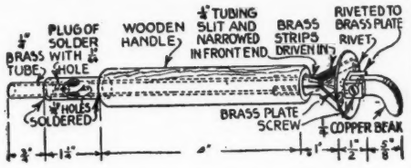
THE HOME WORKSHOP

How to Make a Bench Soldering Copper for Small Work

OFTEN an experimenter and especially a radio enthusiast needs a small soldering iron that will go into close corners. Such an iron, however, usually cools too quickly.

The sketch shows one that stays hot, goes readily into corners, and also is easy to make. It is really a tiny bunsen burner with a handle slipped over it and a small soldering copper fastened in front.

Take a piece of ¼-in. brass tubing 4½ in. long and slit ¼ in. at one end, in two or four places, using a hacksaw. Hammer the slit end all around until the diameter has been reduced to about ⅛ in. Cut off a 1¼-in. length from a piece of tubing just large



Small bunsen burner keeps copper hot

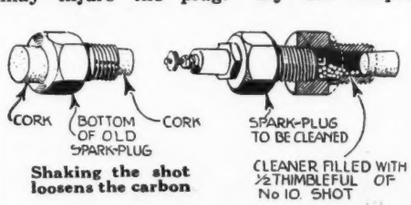
enough to slip over the piece previously prepared. Drill three ¼-in. holes spaced equal distances apart around the middle of this piece and slip it over the first piece for a distance of about ¼ in. Solder the two together.

Fill one end of a piece of ¼-in. tubing 1¼ in. long with solder and drill a 1/64-in. hole through the solder. Then push this end into the larger piece until it reaches the ¼-in. holes in that piece and solder it there. Slip a wooden handle ¾ or 1 in. in diameter over the long ¼-in. tubing so that the narrowed end projects from ¼ to 1 in. Drive in two brass strips about 1/16 in. thick and 1¾ in. long between the handle and the tubing for a distance of ½ in., bend them over and rivet their other ends to a 1-in. disk of 1/16-in. or thicker brass. To this rivet a U-shaped piece of brass, the inside of the U being about ⅛ in. across. This must be drilled and tapped for a screw to hold the soldering copper, which may be of any shape desired. A gas tube is slipped on the other end.

I have used the soldering iron I have at present for more than a year and do not think I could get along without it in the work I am doing.—D. GILLESPIE.

Shot Cleans Spark Plugs

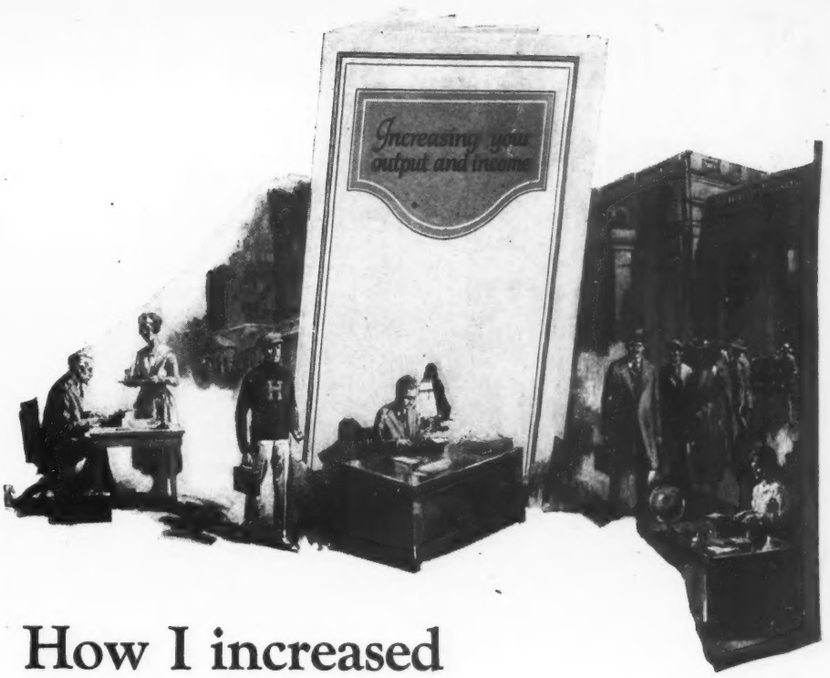
SCRAPING carbon from a spark plug is a slow job and if not carefully done may injure the plug. By the simple



Shaking the shot loosens the carbon

method illustrated, one may easily, quickly, and safely clean a foul plug.

The shell of an old spark plug, two corks, and half a thimbleful of No. 10 shot are used. Remove a cork, pour in a little gasoline and screw the shell to the plug that is to be cleaned, and shake well. The tiny pellets loosen the carbon, while the gasoline washes it off.—T. H. LINTHICUM.



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Blueprint Shows Working Details of This Unusually Attractive Shaving Stand with an Illuminated Mirror

SHAVING is made easier for a man who has a cabinet like the one illustrated. He can keep his razors, mug, shaving soap, strop, and accessories in the cabinet, ready for use without the least waste of time. The whole cabinet can be swung around on casters so as to get the best light, and, if artificial light has to be used, provision is made for a series of ten miniature electric bulbs set in the frame around the mirror so that a perfectly even, shadowless illumination is thrown on the face.

The cabinet should be made of any suitable soft wood and finished in one of the many standard white or cream enamels. If it is not to be placed in the bathroom, a cabinet hard wood in a natural finish should be used, such as oak or birch.

The construction has been arranged in such a way that a minimum of work is necessary. Simple joints have been used in base, pedestal, and cabinet, and the moldings are either stock patterns that can be purchased at any lumber dealer or are so designed that the amateur mechanic can make them himself with ordinary carpenter's tools.

The cabinet proper is 14 in. wide, 10 in. deep, and 12 in. high. It has a plate-glass shelf 5 in. wide supported on small standard nickel-plated shelf supports.

The base is a plain piece of ⅞-in. board with four feet screwed on cornerwise. The post is made of four tapered ⅞-in. pieces making a column 5 in. square at the bottom and 3 in. at the top. Planted on this column are ¼-in. thick corner strips, which give the effect of panel work and conceal the joints in the pedestal.

The cabinet is attached to the pedestal and the mirror post is fastened to the cabinet simply and ingeniously with wood screws that are invisible when the work is completed.

Before making the mirror frame it is well to obtain the mirror that is to be used and then plan so that the frame fits the glass. If desired, a small wooden or metal shaving mirror and stand may be purchased and mounted on the cabinet.

Everything handy and a fine light

The lighting of the mirror is accomplished by the use of ten small electric lights, the exact type, size, base, and wiring being indicated on the blueprint. If a metal frame is purchased or it is not desired to use the small lamps, two tubular or candle-flame 110-volt lamps should be mounted on each side of the mirror.

The blueprint of the shaving-stand, like most of the others in the Home Workshop Service Department's series, will be sent to any address for 25 cents. This cost represents only that of blueprinting, postage, and handling; the relatively heavier charges of designing and drafting are met by POPULAR SCIENCE MONTHLY as a supplementary service for home workers who wish plans on a larger scale and more detailed than it is possible to present in the magazine itself.

In ordering blueprints, please address the Home Workshop Service Department, Popular Science Monthly, 225 West 39th St., New York. It is not necessary to use the coupon if you do not wish to mutilate your copy of the magazine, but be sure and specify which print you wish.

Efficient Crystal Receiving Set

FOR radio enthusiasts who wish to make a crystal receiving set, the Home Workshop Service Department has prepared a blueprint showing the exact details of construction of an unusually efficient set of this kind. It will serve well for the reception of broadcasting within a radius of 25 miles, provided no unusual conditions of interference or "screening" exist.

The features of the set are: 1. A special variocoupler of simple construction. 2. A variable step-by-step condenser that can be made at home. 3. A duplex detector.

The only large item of expense will be the telephone head set.

The blueprint contains drawings of the most suitable aerial and a complete bill of materials. Please use the accompanying coupon in ordering.

If you wish to make a vacuum tube set with or without two stages of amplification, send for Blueprint No. 6.

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5.	Kitchen Cabinet	25c	☐
6.	V.T. Radio Receiving Set	25c	☐
7.	Crystal Receiving Set	25c	☐
8.	Shaving Cabinet	25c	☐

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THE HOME WORKSHOP

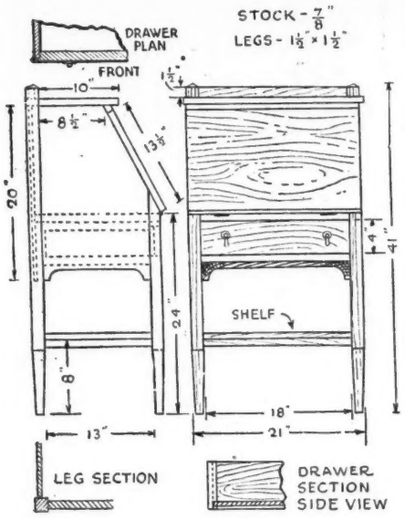
How to Build a Typewriter Desk that Takes Up Little Room

By Clifford A. Butterworth

THIS small typewriter desk is designed for those who use a typewriter at home but for whom the ordinary large desk is usually out of the question because of lack of space. The desk is lower than a table, provides a place to keep the machine when it is not in use, and is small enough to fit in an out-of-the-way corner. It is 21 in. long, 16 in. deep, and 41 in. high. Inside it is 15 in. by 19 in. and 12 in. high; that provides plenty of space for any machine.

A good wood to use is oak, though a softer wood, such as whitewood or cypress, may be used if desired. The stock is ⅞ in., except for the legs, which are 1½ in. square, and for the drawer, which is ½ and ¼ in.

The sides and back are made first. The back is 18 in. wide and 20 in. long. After the sides have been glued together, two



Front and end views of the desk

cleats are screwed on. One supports the desk bottom and is 1 in. wide and ⅝ in. thick; and the other, on which the drawer slides, is 1½ in. wide and ⅞ in. thick. The upper cleat also serves as a drawer guide.

The legs are tapered at the bottom to 1 in. square, beginning at a joint just below the side stretchers. The stretchers are doweled or mortised in place.

The drop leaf is 21 in. long and 13½ in. wide. It should be well doweled and glued with 2-in. end battens to prevent its warping. When open, the drop leaf is supported by a brass chain at each side. A still neater fastening is by means of combination desk-lid supports and hinges.

The drawer sides are of ½-in. stock and are fastened to the front with glue and nails, the joint being made as shown in the drawer plan. The bottom is of ¼-in. stock or three-ply veneer.

There are several ways in which the desk may be finished. The easiest method is to use a varnish stain of the desired shade. For a better finish the wood is first stained, then filled, if oak, and then shellacked and varnished. It is also possible to get easily applied stains such as are used on mission furniture.

SMALL dies can be tempered to a light straw color if heated to the point of just fusing wire solder before quenching.

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P.S.

Toolmaker's Improved V Block Has Wide Range of Utility

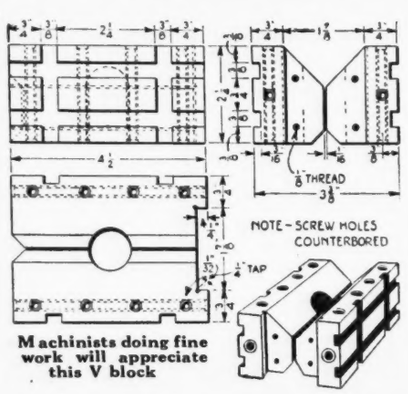
By Henry S. Laraby

(First "Best Idea" Prize for June)

WHILE there are small V blocks on the market, they often prove not large enough for certain classes of work; they also have neither a V in the end nor a plate for use when grinding a number of identical pieces. Another feature of the block I have made for myself is the hole, which allows the block to be put on a lug to center the V. This is not found in commercial blocks.

The stock should be soft or tool steel, pack hardened ⅛ in. deep, finished by grinding all over. All V's must be centrally located from sides. Test them with a 10-in. round bar and indicator.

The hole is used for setting the V's centrally on the lathe faceplate and therefore



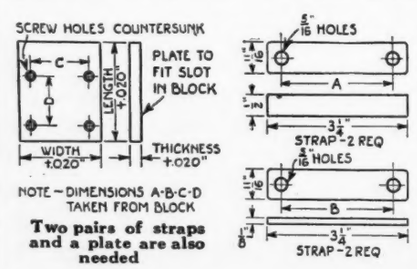
Machinists doing fine work will appreciate this V block

must be absolutely central with the V's. Grind the hole out on an internal grinder.

The sizes given are what might be called "tool crib" sizes. Every mechanic has his own ideas about the dimensions of the tools he makes to keep in his own chest. Tool-chest sizes are usually 3½ in. long, 2¾ in. wide, and 2 in. high.

In addition to the parts shown in the accompanying drawings, four ⅛-in. screws 9/16 in. long, two ¼-in. screws 1 in. long, and two ¼-in. screws 2½ in. long are required.

All the V runouts are 1/16 in. wide; the square runouts, 1/32 in. The ¼-in. holes

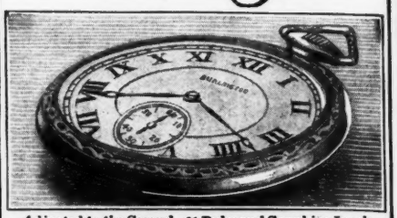


Two pairs of straps and a plate are also needed

are threaded right through the block and counterbored ⅛ in. deep the size of the screw body, to keep the thread from drawing out. The screw holes must, of course, be laid out so as to clear the side slots, which are ⅜ in. wide and 3/16 in. deep. The ⅛-in. screw holes in the plate must be countersunk to take the screw heads flush, and the holes must line up with the corresponding holes in the block.

The wide utility of the block is obvious, whether it is used in connection with the lathe faceplate, lathe chuck, or magnetic chuck.

21 Jewel Burlington



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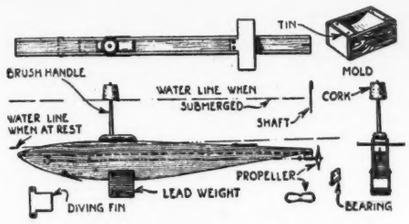
THE HOME WORKSHOP

Toy Submarine Will Travel Long Distance under the Water

By Donald W. Clark

THIS submarine is built of wood and driven by rubber bands used in the same way that rubber is used on model airplanes. It will travel about 50 ft. under water, then come up and run several feet on the surface. The cork prevents it from going too deep and getting lost.

The middle part should be cut from a piece of wood, ¾ in. square and 18 in. long. Cut the sides from ⅛-in. wood and nail them to the square piece. A small block



Plan, elevations, and details of the submersible and mold for lead weight

supports the "periscope" and the cork float is attached to its upper end. The drawings make the rest clear.

To operate, unhook the front end of the rubber motor, place it on a hook in your hand drill, stretch it to twice its length, and wind slowly until the rubber begins to turn hard, at the same time letting it back gradually to its normal length. The drill handle should be turned to the right and the proper number of turns required will be learned through experience.

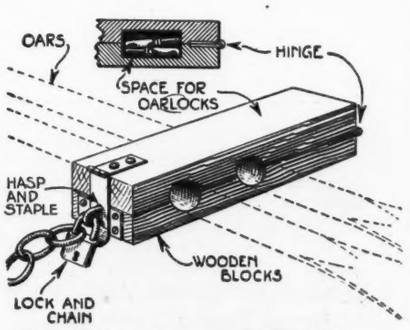
When the motor is wound up, place the boat in the water and let go of propeller.

Numerous trials of this model proved that it works well, and it is surprising the number of times the boat can be run without the rubber giving out. The bands tend to stick together somewhat, but this interferes very little.

The boat will dive under or run on the surface according to the position of the diving fin. The rear fin is necessary to counteract the front one and to keep the propeller under.

Hinged Blocks with a Padlock Prevent Removal of Oars

TWO blocks of wood shaped as shown form a convenient means for locking oars and oarlocks. The pieces are hinged



This device will prevent your boat from being "borrowed" without permission

at one end and connected at the other with a hasp and staple. A recess is gouged out of one of the blocks to provide a place for the oarlocks.—C. P.

Guardians of the Circuits

The telephone at your elbow seems so simple an instrument, it does its work so quietly and quickly, that it is difficult to realize the vast and complex equipment, the delicate and manifold adjustments, the ceaseless human care "behind the scenes" in the central offices.

Behind the scenes is the terminal of all the underground and overhead lines on the streets and highways. Here are the cable vaults; the great steel frames containing the thousands of separate wires and fuses for the subscribers' lines; the dynamos and storage batteries; the giant switchboards through which your telephone is connected with the other thirteen million telephones in the Bell System.

And here, in charge of this equipment, are the guardians of the circuits—the wire chief and his assistants—master electricians and experts in telephony. Their first duty is the *prevention* of "trouble." By day and by night they are constantly testing the central office equipment, the overhead and underground lines, the subscribers' individual wires. And when, from some cause beyond control, "trouble" does occur, nine times out of ten it is repaired before the telephone subscriber suffers the slightest inconvenience.

It is the skill of the men behind the scenes, together with scientific development and construction, efficient maintenance and operation, which make it possible for you to rely upon the telephone day and night.

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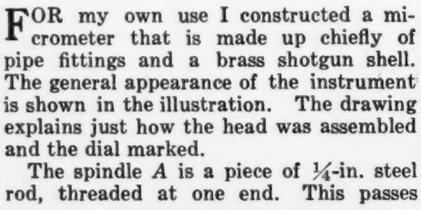
THE HOME WORKSHOP

Shotgun Shell Forms Dial of This Ingenious Micrometer

By Francis H. Van Hise

FOR my own use I constructed a micrometer that is made up chiefly of pipe fittings and a brass shotgun shell. The general appearance of the instrument is shown in the illustration. The drawing explains just how the head was assembled and the dial marked.

The spindle *A* is a piece of ¼-in. steel rod, threaded at one end. This passes



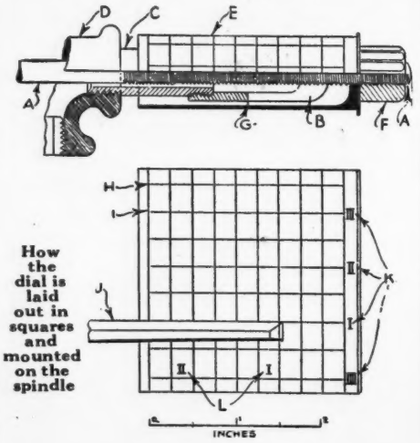
Measurements to 1/200 in. are made with this 2-in. micrometer

through the piece *B*, which is a cap fitting on the short piece of pipe, *C*. This piece screws into the pipe tee, *D*.

After tapping the cap *B* so that it was a very tight fit for the spindle, I split it with a hacksaw as far as the point marked *G*.

The dial *E* is a 12-gage brass shotgun shell. To lay it out, I removed the faceplate of my lathe and divided it into 8 equal parts. Then I turned a piece of wood to fit into the open end of the shell and placed this in the lathe, fastening a lathe dog to the outer end of the stick and tying it as tightly as possible. I revolved the head of the lathe until a pointer attached to the lathe was exactly in line with one of the marks on the faceplate. Next, I adjusted a very sharp diamond-pointed tool, laid on its side, so that it would just scratch the brass shell, and fed the carriage by hand so as to make a fine and accurate line the length of the shell.

After marking out the eight lines in this fashion, I turned the tool and made the lines around the shell, ¼ in. apart. When



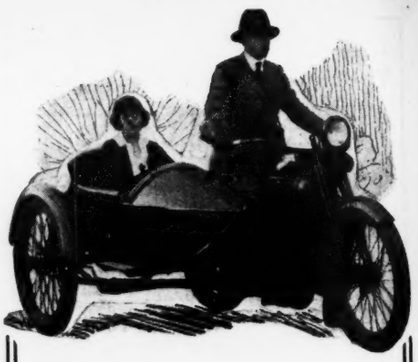
How the dial is laid out in squares and mounted on the spindle

the shell had been fitted to the spindle, I used a nut from an old sight-feed lubricator (*F*) to lock it and to serve as a handle. Holding the spindle true is accomplished by *B*.

The anvil is adjustable, as shown in the photograph. The pointer *J* is held to the pipe tee by a screw and two pins.

The spindle should have 25 threads to an inch if the micrometer is to read in

(Concluded on page 89)



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Write Today Send your name now. Tell us which of the solid gold rings illustrated above you wish (ladies' or men's). Be sure to send finger size.
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THE HOME WORKSHOP

Shotgun Shell Forms Dial of Ingenious Homemade Micrometer

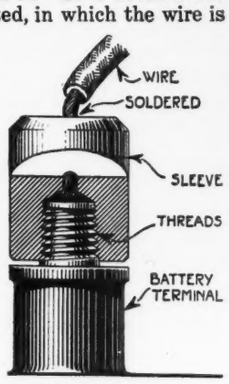
(Concluded from page 88)

hundredths of an inch. The lines marked *K* in the diagram give the hundredths and the lines marked *L* show the inches, half inches, and quarter inches. A little practice makes the reading of the dial quite easy. Since there are 25 threads to the inch, turning the nut and the dial 25 complete revolutions moves the shell 1 in. That advance is registered by the relative movement of the vertical lines on the shell as shown in the drawing past the vertical right-hand edge of the pointer. Each time the space between two of the horizontal lines on the shell passes the upper horizontal edge of the pointer, a distance of 1/200 in. is recorded, and when two spaces pass by, 1/100 in. Finer divisions can be estimated by the eye.

Storage Battery Connection Will Prevent Corrosion of Terminals

CORROSION of the copper wire terminal connections on the positive and negative lugs of my storage battery has always, in time, caused a high resistance connection and given me no end of trouble.

The positive terminal especially seemed subject to corrosion and a white deposit would form on the smooth part where the clamp fitted around it. So I devised the connection illustrated, in which the wire is soldered inside the top of the threaded sleeve. Taking off and putting on the sleeves keep the threads bright and insure a good contact.



Sleeve screws on terminal lug

To make a pair of these connections, move the ring or clip on both terminals and measure the diameter across the top of the terminals. Obtain a cheap 10-cent die and a tap of a size to suit. If you have no lead rod to form the sleeves, melt down a few pieces of scrap lead and pour into a tin or heavy cardboard tube about ¼ in. larger in diameter than the terminals and saw off two pieces about 1 in. long. Drill a ⅛-in. hole through each sleeve, and then, with a drill slightly smaller than your tap, drill about ¾ in. Run the tap carefully into this large hole and back it out slowly. Next run a wire into the small hole in the top of the tap and solder it inside by dropping in a small piece of solder and heating the sleeve. Run the die carefully down over the battery terminal. Screw the sleeves and wire to the lugs and you will have a fool-proof electrical and mechanical connection.—J. R.

How to Drill Sheet Metal

LARGE holes may be bored clear through sheet brass or steel with a twist drill by clamping a piece of hardwood board on either side before drilling.—S. N. W.

Radio Hook-Ups

In this book are shown all the best circuits for damped and undamped wave receiving sets, buzzer, spark coil and transformer sending equipment, as well as vacuum tube telegraph and telephone transmitters, wavemeters, vacuum tube measuring instruments, audibility meters, etc.

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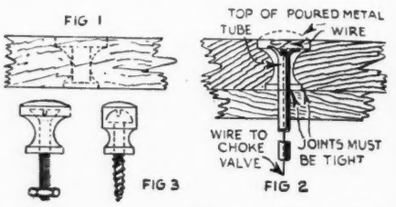
Tea-Foil Castings Serve Many Purposes

I DO not believe that the utility of tea-foil is generally recognized. I have made good use of it in casting small patent models as well as several serviceable articles.

It possesses characteristics that render it especially adaptable. It is easily melted and may be cast in wood molds. The casting can quite easily be dressed and refined with an emery-wheel, fine files, and emery-paper. A little buffing will give it a neat finish. It is tough and may be used for many purposes where the strain will not be excessive.

Poplar is the best wood I have found for molds. It is easily shaped and does not burn out as readily as does a more resinous wood. If the molds are properly made, they may be used many times.

To suggest methods of handling the material, I will give a brief explanation and sketches of some simple projects I have made. Figures 1 and 2 show a choke button for an auto. The dotted lines in Figure 1 explain how the holes were bored and shaped to make the mold for the button proper. Figure 2 shows the mold with the guide and choke wire in place, ready for pouring. The guide is a metal tube 2¾ in. long, spread at the top to form a binder in the metal. The wire is passed through the tube and coiled slightly. All joints must be tight or the metal will run through.



Mold for an automobile choke button and two small cast knobs

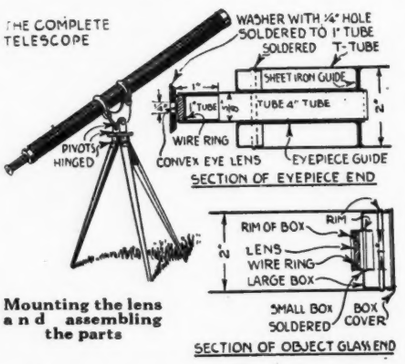
Figure 3 shows knobs made in about the same manner as the choke button. In these projects the mold is split off after the metal has cooled. Where several articles are to be made alike, the poplar molds may be made in parts and used over and over again.—GEORGE N. WEAVER.

How to Make a Small Telescope

By Jule W. Dennis

THE telescope described in this article was made by the writer and has been used in studying the moon and the planets.

First obtain a common spectacle lens of 4 or 5 ft. focal length. It should be one of the old flat type which has much better defining power than the new greatly curved type of lens. The focal length is easily found by holding the lens in the sun and measuring the distance from the lens to the point where the light comes to a small clear circle. Also secure a small double convex lens such as is used in the view-finder of a camera.



Mounting the lens and assembling the parts

Have a tinner make a sheet-iron tube, 2 in. in diameter and 3 in. shorter than the focal length of the spectacle lens, or object glass. A section of good 2-in. rainwater drainpipe could be used for this purpose.

From a drug-store buy two 1-oz. salve-boxes; these will fit snugly in the tube. Get a smaller salve-box about 1 in. in diameter and grind the object glass on a grindstone to fit inside it. Cut the bottom out of the small box, leaving only a small ring on which to seat the lens. Cut a hole in one of the large boxes just large enough so that the small box will fit into it. Solder the small box into the large one and then solder them both into one end of the telescope tube, with the bottom of the box inside. Seat the object glass in the small box, using a piece of round spring wire to hold it in place.

Take the other large box and cut a round hole in the center of it, ⅝ in. in diameter. Cut a round piece of heavy sheet iron to fit tightly inside the telescope tube at right angles and bore a ⅝-in. hole in the center of it.

Make a round tube of tin 3 in. long and ⅝ in. outside diameter. Solder one end into the salve-box and the other into the round piece of sheet iron. Push the whole into the telescope tube, sheet-iron guide first, until the box is flush with the end; then solder firmly. This will form the guide in which the eyepiece tube slides.

Two more tin tubes are needed, one 4 in. long, which will slide easily in the eyepiece guide, and a tube 1 in. long, which must fit tightly in the 4-in. tube. Solder a round piece of sheet iron or a washer to one end of the 1-in. tube. This washer should have a ¼-in. hole in it.

Now seat your eye lens against the washer and fasten it in place with a piece of spring wire, like the object glass. Push the 1-in. tube into the 4-in. tube, and the whole into the guide.

Before the telescope is used, it should be blackened inside with lampblack or liquid stove-polish to prevent reflections. The tube will look much better if covered on the outside with imitation leather. The telescope may be mounted on a tripod, if desired.

To ascertain the magnifying power, divide the focal length of the object glass by the focal length of the eyeglass, the result being the magnifying power. For the writer's 5-ft. telescope the magnifying power is 80 diameters.

To focus on the moon or other object, slide the eye tube in and out until the image is clearly defined.

To get the most pleasure out of wireless you will want a loud speaker. Then you can entertain a group of friends—hear the wireless telephone programs clearly all over the room—actually dance to wireless music—just like a phonograph.

All loud speakers require vacuum tube amplification. The heart of the amplifier is the transformer.

ACME Transformers

have been brought to a high degree of efficiency through years of specialization on this one product. They amplify wireless telephone without detracting from the original tone value.

Acme transformers are for sale separately and also incorporated in complete Acme Instruments.

The **ACMEFONE**, illustrated below, is a complete long range installation. It includes in one handsome cabinet, the tuner for selecting the particular station you want to hear, the equipment for three vacuum tubes to amplify (or magnify) the sounds, and a loud speaker which sends the voice and music clearly all over the room. The price is only $80.00. The only additional equipment you will need is an aerial, three vacuum tubes, two "B" batteries and a storage battery. The work of installation has been reduced to the mininum. Simply put up a simple aerial, insert tubes, hook on batteries and you are ready to listen.

Other Acme Apparatus includes vacuum tube detector and amplifier equipment, designed to hook on to your present receiving equipment and prepare the way for a loud speaker. Acme apparatus is backed by the reputation of the oldest manufacturer of transmitting apparatus in the country and is for sale at all radio dealers.

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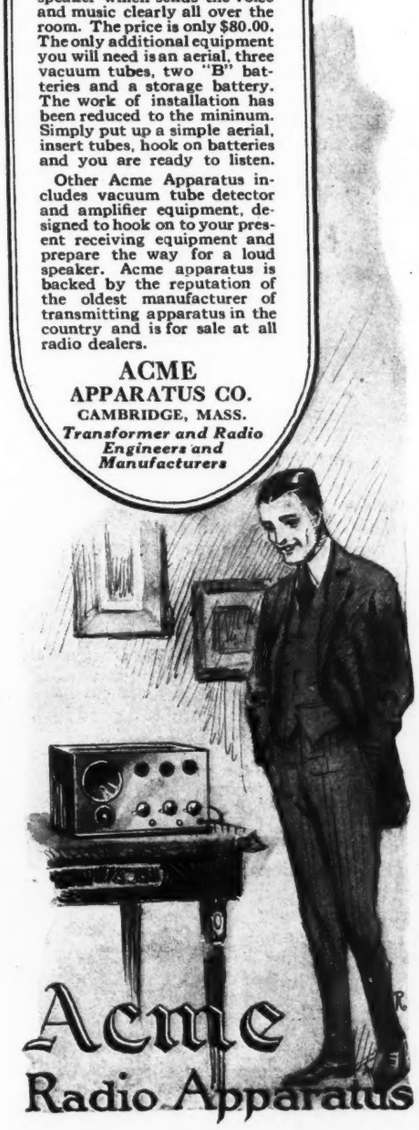


Acme Radio Apparatus

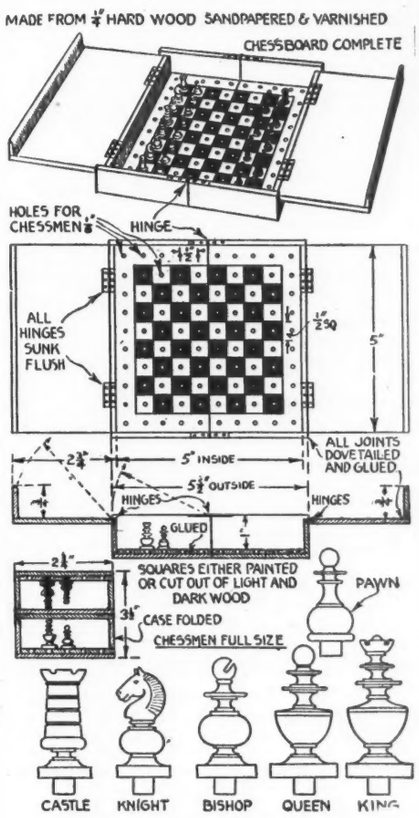
THE HOME WORKSHOP

A Folding Game Case for Chess and Checkers Players

FOR those who play chess and checkers, this folding game set will provide an interesting problem in woodwork. The case itself is a shallow box, cut in two and hinged in the middle. There are two wooden flaps at the ends that serve the double purpose of retaining the chessmen in their respective places and forming one end of the box when it is closed.

The chessmen may be turned from boxwood, ivory, ebony, or metal, with the exception of the four knights. The base of these latter may be turned, but the horses will have to be carved. For such small chessmen, a very simple design may be used, and if a lathe is not available, all the pieces may be carved from ⅜-in. dowels. A pin is provided at the bottom of each piece to fit holes drilled in the center of each square. Similar holes are arranged around the margin to hold "taken" pieces.

The checkers are turned or sawed from a dowel and stained or enameled.—C. W.



After the flaps are shut the box folds together compactly

Resurfacing Old Oilstones

WHEN an oilstone becomes glassy or "hard" in spots and is too oily, there are several methods for restoring it to serviceability.

To remove the surplus oil, place the stone near a hot stove and when it is thoroughly warmed, rub it on a cement sidewalk or floor, using a little sharp sand and water as an abrasive. It may be necessary to continue the rubbing for fifteen minutes.

Sometimes it will be found sufficient to rub the oilstone a few times with kerosene and turpentine instead of the usual oil.—C. C. SPREEN.

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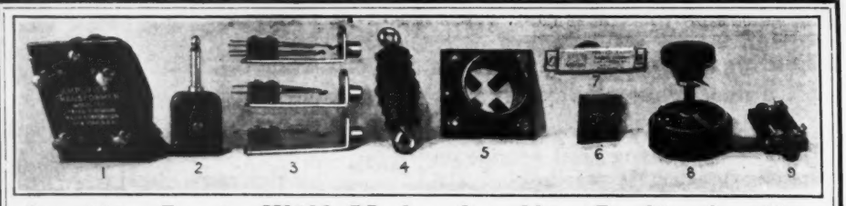
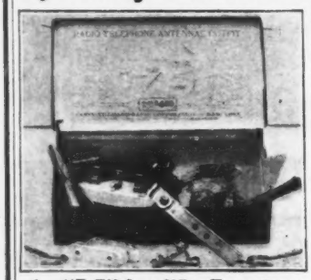


Quality Parts Will Make Quality Radio Outfits



Are you one of the hundred thousand people who are about to build your own radio outfit and get in on the most fascinating sport in the world. It is easy to build your own receiving set and it can be done at a low cost and will give absolute satisfaction provided the materials and parts which you use are correctly designed.

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"F-E" Radio Telephone Antenna Outfit. Complete antenna equipment; may be used with any radio receiving set. This outfit comprises all necessary antenna wire, insulated wire, switches, ground clamp and simple instructions for putting up. Model 128.. **$2.50**

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An audio frequency transformer, designed to give maximum amplification without distortion, and suitable for use with high impedance amplifying vacuum tubes. Model 120, **$7.50**

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This plug has innumerable use in vacuum tube receiving and sending sets. Can be used with spade tips, pin tips or solid wire connections. No parts to lose or break. Model 103, **$1.75**

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Aluminum shell, German silver contacts, insulated base. Especially adapted for radio as well as audio frequency amplifiers, detectors, etc. Price, **$0.75.**

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These are built of the best mica and pure tin foil. The condensers are compressed and impregnated in paraffin. Capacities are permanent and losses extremely small. Price, **$0.35.**

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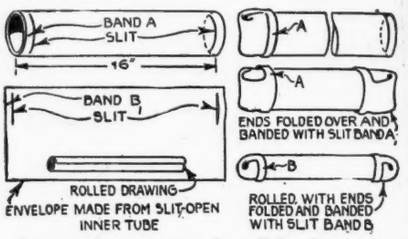
THE HOME WORKSHOP

No Cement Used in Making This Waterproof Rubber Envelope

FOR three years I have used in the locker of my car a waterproof envelope for my license and papers made from an old inner tube without the use of cement.

Use a fairly good tube and cut slits as shown in the upper left-hand sketch. Then



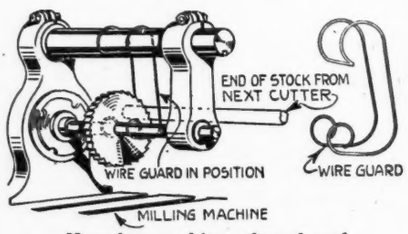
A pouch for papers and a roll for drawings

fold as shown in the two upper right-hand drawings. To make a roll for drawings, cut slits in a tube that has been opened from end to end and fold as shown in the lower sketches.

The now time-honored use of inner tubes for re-soling and -heeling rubber shoes is another idea well worth while, for if the rubber is applied with two coats of cement, the soles and heels will wear like iron.—W. W. PARRY.

A Milling Cutter Guard

DIFFICULTY arose in a machine-shop because stock that was being cut off in one milling machine protruded into the path of another. A wire guard was then

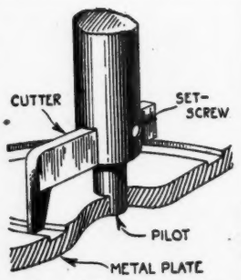


How the guard is made and used

made so as to fit over the beam and bear against the side of the arbor. The radius of the bottom loops of the guard was great enough to keep the vertical part clear of the cutter.—W. SAUL.

Cutting Large Holes in Plate

IN cutting large holes in plate, or in fact, in any material, I found it a good idea to make and use a tool like that illustrated. It can be used on a lathe, drill press, or even in conjunction with a hand brace. It is easy to adjust and saves the purchasing of large drills.



This tool has a wide range of adjustment

The tool is a piece of ⅜ by ¾ in. tool steel, shaped as shown. All that is necessary is to drill a small center hole to suit the pilot and set the tool to the required diameter.—J. H. MOORE.

THE HOME WORKSHOP

"Heeling Down" a Sailboat with a Water-Filled Barrel

THE difficulty of passing a low bridge won't worry the amateur boatman if he knows the fisherman's little trick shown in the accompanying illustration. A barrel filled with water will provide sufficient

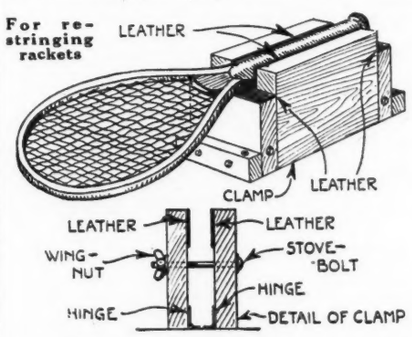
Two examples of how the barrel expedient saves time and labor

weight to heel down a good sized sailboat.

Another use of the same expedient is in making repairs to the boat's bottom instead of beaching the boat.—J. D. G.

Vise for Tennis Rackets

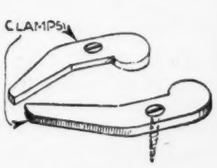
FOR holding tennis rackets that are to be restrung, I find that the homemade vise shown in the accompanying illustration is as satisfactory as any I have ever used.



The wooden vise jaws are hinged to the bench and drawn together with a stovebolt and wingnut. Leather facings are glued on to protect the racket handle from injury.—JOHN M. LANG.

Woodworking Bench Clamp

FOR quickly jointing the edges of boards on the bench an adjustable bench clamp, made either of tough hard wood, or of iron or brass at least ¼ in. thick may be used. The pressure of the board against the V formed by the levers tends to force them apart and consequently their round ends press tightly against the wood to be planed. By adjusting the clamps boards all of stock thicknesses can be accommodated.—R. T. J.



Adjustment is automatic

Stevens "Visible Loading" repeating rifle (price $15.00) has the same accuracy found in model 415, pictured below.

The gun behind the man

An amusing incident in the history of American marksmanship

Stevens No. 414 Ideal "Armory" Model—used by almost every indoor or outdoor rifle team—designed particularly for such service. Retail price, including tax, $23.50

Once when picked teams, representing various national armies or guardsmen, met at Bisley, England, to shoot for the Palma Trophy, the United States team was furnished with Stevens barrels.

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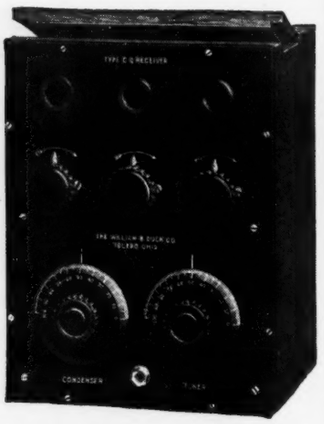

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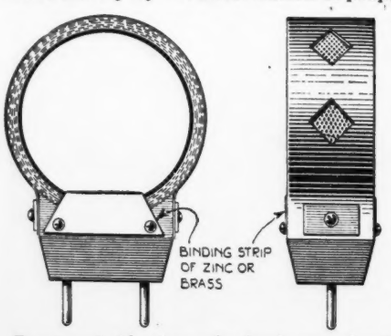
THE HOME WORKSHOP

How I Made Bank-Wound Coils for Short-Wave Reception

By Harry L. Gray

HONEYCOMB, or lateral wound, tuning coils, have been found to be very efficient in all wave lengths above 450 meters and to give results on broadcasting waves equal to those obtained from the ordinary loose coupler or double slide tuner. The common types of tuning devices are limited in their range, but the station equipped to use honeycomb coils can pick up messages from 200 meters to 20,000 meters merely by the substitution of proper



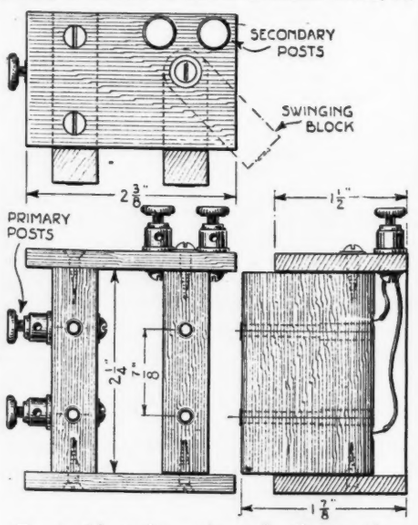
Front and side views of a bank-wound coil

coils in the coil mounting. It should be noted, however, that the honeycomb coils are covered by U. S. letters patent.

In winding my own coils I found that the size of wire makes little difference except as to the space taken up. Numbers 22, 24, or 26 wire will give equal results as far as an amateur can perceive. My coils for receiving broadcasts at 360 meters were made as follows:

I secured a wooden block that could be fitted tightly inside a pasteboard tube 2 in. in diameter. The pasteboard tube was cut to a width of 1 in.

After the tube had been slid over the block, I drilled a series of small holes, ¼



Front, side and top views of coil mounting

in. apart, completely around the edge of the tube on both edges. Into these holes pegs or brads were driven, leaving them projecting about ½ in. The spacing of the pegs I found to be the same on all coils whatever their wave length, but the thickness of the winding varies with the amount of winding applied.

The coil was wound according to the winding diagram. I attached the end of the wire

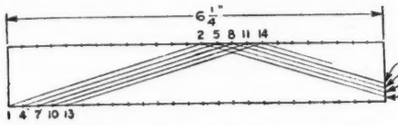
(*Continued on page 95*)

THE HOME WORKSHOP

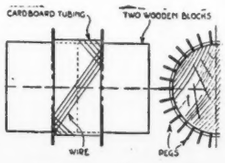
How I Made Bank-Wound Coils for Short-Wave Reception

(Continued from page 94)

to one peg taken at random, counted off the eighth peg on the opposite side and carried the wire to that point. Then I counted off eight more on the starting side, led the wire to that, and so on. The pattern for each coil was arranged so that after each revolution of the winding the wire appeared

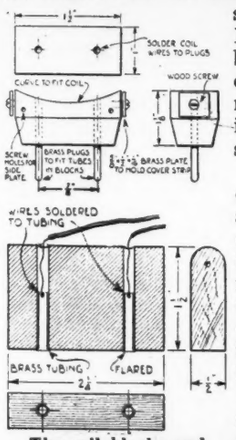


at the peg just before the one used to start the preceding round. This form of winding was continued layer upon layer until the desired length had been applied, which, in the case of the broadcasting coil, was 155 ft. of No. 24 wire. The exact amount of wire needed, I found, depended on the aerial, the capacity of the condensers used, and other tuning devices, and the figures given above are approximate.



Winding diagrams

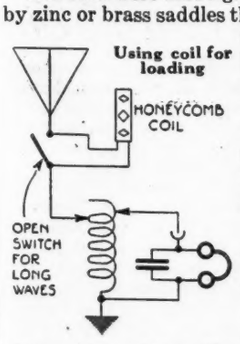
After the coil had been completed, it was well coated with the best quality of white shellac obtainable. I discovered it was better to leave the coil uncoated rather than use an inferior grade of shellac.



The coil blocks and the connections in coil mountings

Finally the circular coil had to be arranged so that it could be plugged in or out of the coil mounting. To do this, I took a block of hard wood 1½ in. by 1 in. by 1⅛ in. and at a point ⅝ in. from one flat side chamfered slightly to give a finished effect. Then on the side opposite the chamfer I scribed an arc that agrees with the outer surface of the finished winding. I bored two ⅛-in. holes through each block and in the holes drove a piece of ⅛-in. brass rod. Then I rounded off one end and attached the ends of the coil winding to the other ends, as shown in the diagrams.

The coils were held rigidly to the coil block by zinc or brass saddles that passed up from the flat side of the block, over and through the inside of the coil and down the other side of the block, where they were fastened.



Using coil for loading

Although not essential, an added finish was given to the coils by covering their outer surface with a strip of thin fiber board.

After the coils were completed, a mounting was provided so that the one coil could

(Concluded on page 96)

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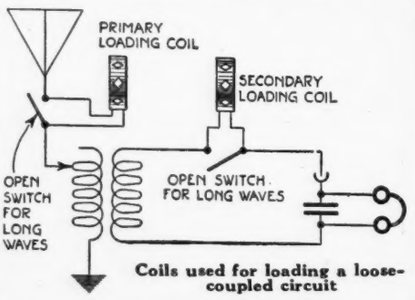
THE HOME WORKSHOP

How I Made Bank-Wound Coils for Short-Wave Reception

(*Concluded from page 95*)

be substituted for the other in changing wave lengths and also in order that one coil could be swung sidewise for closer tuning.

These mountings I made to accommodate either two or three coils, according to the circuits in use. For the two-coil mounting, said to be equal in its effects to a loose coupler, the drawings show the measurements and the method of assembly I used. I secured two pieces of hard



Coils used for loading a loose-coupled circuit

wood, well dried, 2¼ in. by 1½ in. and ½ in. thick. One of these was for the permanent mount and the other the swinging mount. I took two other pieces 2⅜ in. by 1½ in. by ¼ in. thick for top and bottom supports and attached the coil mounts as shown in the drawing.

In one face of each of the mounts I bored two holes 3/16 in. in diameter completely through the wood. Then I obtained some short lengths of brass tubing, 3/16 in. outside diameter and ⅛ in. inside diameter and soldered a 2-in. length of flexible cord to each tube, inserting a tube in each of the four holes with the flexible cord leading toward the back.

A good assortment of these coils was assembled in my case by winding six or eight sets with a difference of five layers in each set. That is, in the broadcast coil just described about ten layers were needed. With these coils I experimented until I found the proper combination for every station, whether it is an amateur of 200 meters or one of the transatlantic stations with 14,000 meters.

Comfortable Camp Bunks Made from Sacks and Saplings

A SIMPLE but comfortable camp bunk may be made from two sacks and a few saplings. Two rails are provided, 2 ft. longer than the sacks, and slipped inside them and through slits at the bottom corners. Two stout forked sticks are sunk

into the ground, a little more than the length of the sacks apart. Then two short saplings are leaned at an angle into the forks, and the rails are dropped across these slanting sticks.—W. J. BEACH.

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THE HOME WORKSHOP

Government Experts Tell How to Make a Radio Set for $10

By Franklin S. Keating

TEN dollars, according to wireless experts in the Bureau of Standards, will build a receiving set that will permit an amateur to listen in on signals from navy stations 200 miles away and from broadcasting stations 25 miles distant. The set is one that can be built at home, the final cost depending on the cleverness of the worker with the tools and materials available.

The knowledge of radio gained in the construction and operation of this set will form a sound basis for later sets of greater power and receiving range.

—THE EDITOR.

YOU can build a $10 radio set, consisting of tuning coil, crystal detector, and phone, as planned by government wireless experts, by following these detailed directions.

For the tuner secure a cardboard tube 4 in. in diameter. The cores around which linoleum is wound are ideal for this purpose and can usually be obtained free at a housefurnishing store. If not procurable there, the round cardboard boxes of certain kinds of breakfast foods, while thinner, can be used if handled carefully.

For the coil secure ½ lb. No. 24 double cotton-covered copper wire. If this size is not available, the next size above or below will make but little difference. Beginning at a point ½ in. from one end of the tube, punch two holes through the cardboard. Put one end of the wire down through one hole and up through the other, until the end is firmly anchored, leaving about 12 in. for the connections. Wind on 10 turns of wire tightly and closely, and then, while holding the turns, arrange a loop for a tap. Do this by punching two holes, as at the beginning, and passing down and up through them a 6-in. loop of the wire. With this done, wind on 10 more turns and take off another loop. But instead of taking off the second loop directly beneath the first, "stagger" it about ½ in. This makes it easier to carry the connections to the switch points without short circuiting them.

Continue winding in the same manner until the seventieth turn, making six taps in all. Then, commencing with the seventy-first turn and continuing for 10 turns, take off a tap from each turn. At the last tap, anchor the wire firmly, leave 12 in. for the end connection, and cut the wire from the spool.

Use Brass Screws for Switches

Now lay the tuner aside while the other parts are finished. Secure a piece of wood ½ in. thick, 5 in. wide and 8 in. long to be used as the panel. Remove two binding posts from old dry cells and attach to the panel at points 2 in. apart. Drill the first hole for the top binding post ½ in. from the top and ½ in. from the left-hand edge.

Next, lay out the two switches with their handles and the necessary switch points. For the handles, drill two holes at the same height as the lower left-hand binding post, 3 and 6 in. respectively from the left-hand side. With these holes as a center, draw a circle 1½ in. in radius to locate the switch points.

Switch points can be made by taking 18

(Continued on page 98)

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Charging ask for Free ROTARY RECTIFIER Bulletin No. 17B.
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THE HOME WORKSHOP

Government's Cheap Radio Set

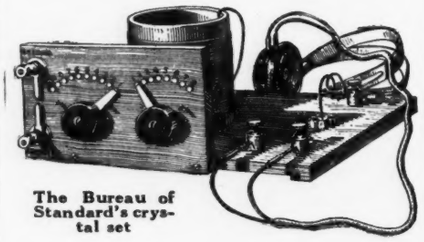
(*Continued from page 97*)

¾-in. round head brass screws and filing the heads down to a flat surface. They are inserted in holes drilled along the circle, separated by a distance equal to the diameter of the head.

The taps taken from the single turns are fastened to the left-hand switch and those from the "tenth" turns to the switch on the right.

The switch arms or handles may be purchased from a supply store or can be made by sawing a slice from a broom handle with a piece of brass rod or bolt passing through the wood to the back of the panel. The brass contact can be cut to shape and fastened to the under side of the piece of wood in such a way as to make contact with the bolt.

The wiring of the panel is then completed by carrying a wire from the ground binding



The Bureau of Standard's crystal set

post—the lower one—to the left-hand switch arm, and connecting the upper binding post—the aerial—to the right-hand switch arm. All that now remains are the detector, condenser, and the binding posts for the telephone.

The detector consists of a piece of galena held securely by wood screws to the base and a fine spring wire attached to a movable arm so that the position of the wire can be changed. The spring wire—an E mandolin string may be used—is wound several times around a small finishing nail after the latter has been slipped through the binding posts. A piece of cork or wood may be used for the knob of the detector or a very good handle can be made by softening sealing-wax and molding it to the desired shape before it hardens. Attach the detector on the extension of the base near the back and the two binding posts for the phone near the front edge. Complete the wiring for the set by connecting the ground binding post with the left phone binding post and the antenna post with one side of the detector. Connect the other side of the detector with the remaining post of the phones and the work is done.

While not necessary to the operation of the set, a fixed condenser placed across the phones will bring in the signals clearer and slightly louder. It is simply made.

Obtain some tinfoil and waxed paper. Cut four sheets of the tinfoil 4 by 3 in. and the waxed paper 4¾ by 3¾ in. Lay down a sheet of the paper and in the center of it place a sheet of the foil, holding the latter in place by a drop of shellac. Connect the tinfoil with the outside by small strips of the same material 2 by ½ in., placing them alternately at one corner and then the other, so that after laying down the four sheets of tinfoil and five sheets of waxed paper, there will be two sets of connections.

Place a piece of stiff cardboard on top and bottom and bind the whole with tape.

(*Concluded on page 99*)

RADIO Equipment

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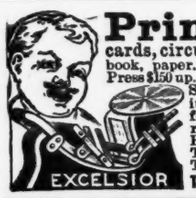

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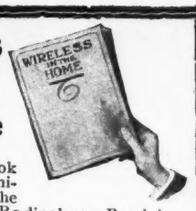
Wireless in the Home



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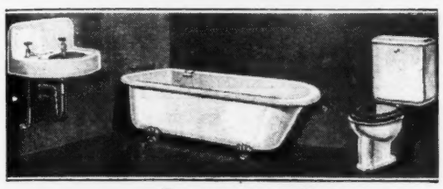

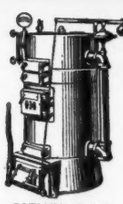

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Genuine Suede Rubber Lined.

Made and Fully Guaranteed by
THE F. S. MILLS CO., Inc., Gloversville, N. Y.

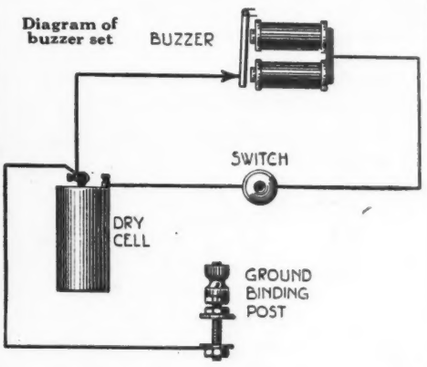
Government's Cheap Radio Set

(*Concluded from page 98*)

Fasten each set of connections together and lay them under the binding posts for the phones.

A single phone receiver can be purchased for as low as 65 cents, but for best results a Baldwin phone costing about $6 should be used with the outfit. This is the most expensive part of the set, but is well worth the cost.

A test buzzer is a worthy addition to any set. Connect a dry cell with an ordinary doorbell — with bell removed — and a homemade switch of any kind. Lead a wire from the vibrating point of the bell to the ground wire and attach it there. If



the crystal is in good adjustment, a loud buzz will be heard in the phones when the buzzer is operated. If the buzz is heard in the set, then wireless signals within the range of the set will also be heard.

In constructing the aerial, height and length are the factors that affect the receiving distance. An aerial 60 ft. high is twice as good as one only 40 ft. high. The single wire of No. 14 bare copper should be made as long as possible, preferably over 100 ft.

It is not necessary that both ends be of the same height. If the end farthest from the house can be attached to a tree or mast, the lower end can be sloped so that it leads directly to the instruments.

The principal parts with their costs are as follows:

Wire No. 24	$0.75	Rope for aerial	$0.50
Cardboard tube	.10	No. 14 wire for aerial	.75
Switch bolts and nuts	.25	Pulleys for aerial	.39
Galena crystal	.25	Insulators	.20
Test buzzer	.50	Tinfoil	.10
Dry battery	.30	Phones	4.50

Where to Buy Home Workshop Equipment and Materials

MANY times in your home workshop you will ask, "Where can I buy this part?" To help you with such problems, the Home Workshop Department offers two suggestions:

The first is to consult the display and classified advertising in this magazine, for there you will probably find listed just what you need.

The second is to send a letter of inquiry addressed to the Information Department, Popular Science Monthly, 225 West 39th St., New York, enclosing a stamped and self-addressed return envelope. The Home Workshop Department's library contains reference books, catalogues, price lists, and data of all kinds in regard to almost every article used by mechanics.

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THE HOME WORKSHOP

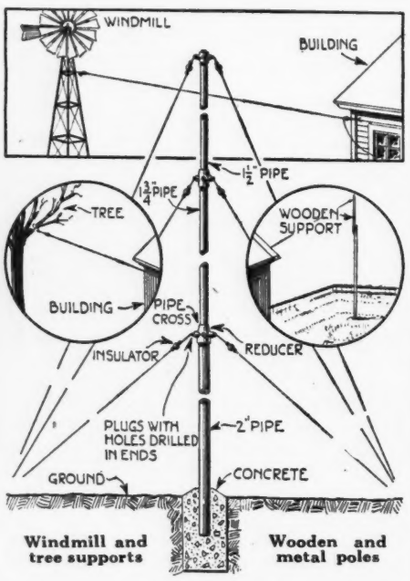
Four Ways to Erect an Aerial for Your Radio Receiving Set

Louis S. McNamara

THERE are two main points to be considered in laying out and constructing an aerial. They are: Make it as high as possible and as near 125 ft. in length as facilities will permit. One wire will do as well as two or more.

The exact manner of erecting the radio aerial will depend on the location of near-by objects from which the wire can be strung. A tree is perhaps the most accessible of anchorages for aerials, but to get best results a mast should be erected in the top of the tree in order to elevate the aerial above all branches. If this is not possible, the aerial can be swung from one of the branches, providing the wire is well insulated from the tree.

Next to a tree a wooden mast, made by nailing together two 2 by 4's to form a 4 by 4,



makes a good aerial post. Two sections, each 20 ft. long, with a 3-ft. splice, will give a mast about 30 ft. high. Such a mast should be prevented from buckling by 3 guy wires attached at or near the splice, although this is not essential if the mast is in a protected place or if the wire span is not long.

But the best aerial mast of all, the most easily erected and the most permanent, is the pipe mast. This can be lifted to any height, providing the bottom section selected is large enough and that plenty of guys are used.

In making a pipe mast the height will determine the size of the bottom section. If a height of about 35 ft. is desired, start with a 2-in. pipe as in the illustration. At one end screw on a pipe cross and in each of the side taps screw a plug with a ¼-in. hole drilled in its head. At the remaining open tap put in a 2- to 1¾-in. reducer for the next section of pipe. The holes in the plugs are for the guy wires.

By thus reducing the size of the pipe in each successive section the aerial mast may be carried up until the final section is ¾ in. in diameter. All bending strains will be taken up by the guy wires.

The bottom section should be embedded for about 18 in. in solid concrete and the whole pipe well covered with red lead to

(Continued on page 101)

Imperial Sanitary Floor

Put on like Plaster
Wears like Iron
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Base and Floor one solid piece

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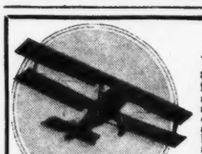

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THOMAS MFG. CO., Chest 447, Dayton, Ohio.

THE HOME WORKSHOP

Four Ways to Erect an Aerial

(Continued from page 100)

prevent rusting. If galvanized pipe is used it need not be painted.

The presence of so many guys is an asset to any station. Each guy wire should be insulated at top and bottom by a simple corrugated strain insulator. Then, if desired, all the wires can be connected with one lead-in wire, thus making a secondary aerial. This secondary aerial could be connected with a switch inside the receiving station for use when stations with longer wave lengths are to be tuned in.

Radio amateurs who live on farms where windmills are used for water pumping are already supplied with an excellent antenna mast. One end of the aerial can be fastened to the top platform of the mill; and the other carried to a hook on the house near the instruments, which completes the aerial.

On all the foregoing types of aerial suspensions, with the exceptions of the tree and windmill anchorages, a pulley should be provided for lifting and lowering the wire A galvanized metal pulley and a ⅜-in. rope will be sufficient. The rope will last longer if it is tarred, but as the expense of tarring will nearly equal the cost of new rope, the advantage is somewhat doubtful.

Serviceable Camping Table Folds Up Compactly for Shipment

AUTO tourists devise much ingenious camping equipment that can be accommodated in the limited space inside their cars. The folding table illustrated below is an example of a serviceable table. When extended, it is of good size, but

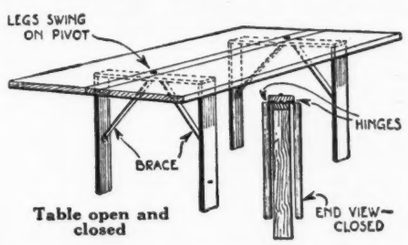


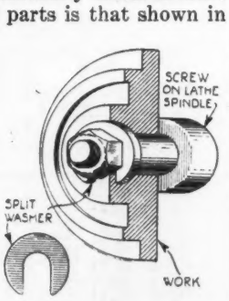
Table open and closed

folded, it is a compact package, easily carried inside the car.

Two large leaves are hinged to a narrow center board, to which the legs are also secured by means of centering pins. To close the table, the legs are turned around beneath the center board and the side leaves are folded against them.—G. A.

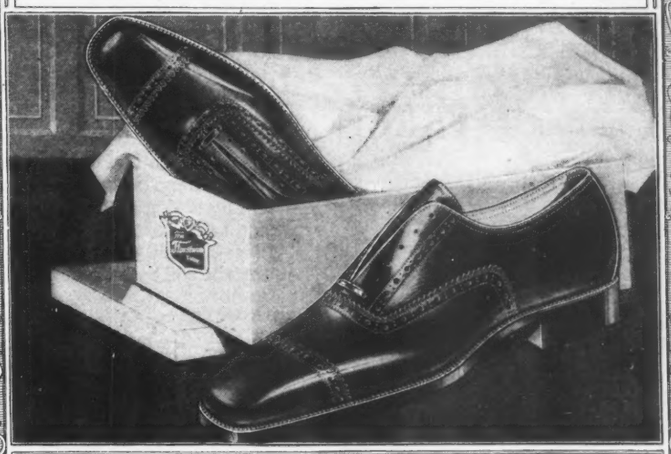
Quick Grip for Lathe Work Helps Speed Up Production

AN expedient occasionally useful in lathe work on small parts is that shown in the accompanying illustration.



When the head of the cap screw or nut is loosened half a turn, the split washer is lifted off and the part can then be slipped off over the cap-screw head or nut, which is smaller than the diameter of the hole through the pieces being machined.

THE FLORSHEIM SHOE



The Fester—Style M-87

WHEN you view your first pair of Florsheim Shoes—remember that their splendid appearance, you so greatly admire, is not merely a surface finish; but a "built-in" quality that will endure for months of constant hard wear.

Florsheim Low Shoes are Skeleton Lined and Non-slip—they fit the ankle and hug the heel.

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Popular Science Monthly, 225 West 39th Street, New York

Jimmy's Diary

Monday, May 8th

"After school hopped on bike and went fishin' with Frank Morey. Comin' home late for supper had a punkture. S-s-s-s-s-s she went and stopt. Gee, I was lucky. It was in the tire I had put Neverleak Tire Fluid in three weeks before. Didn't loose any air because Neverleak stopt the leak."

A 25c tube of Neverleak saves expensive repairs and **makes tires last longer.** At all bicycle and repair shops.

FREE—Send for handy Neverleak Pencil Clip. In attractive colors, holds pencil firmly in place.

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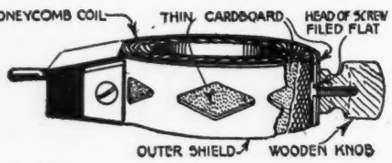
Knobs Fitted to Honeycomb Coils Improve Radio Set

THOSE amateurs using honeycomb coils on homemade sets know from experience that to place the hand on them when receiving "kills" the wave length. This difficulty, which is due to the added capacity of the hand may be largely prevented merely by fitting a small knob on the front of each coil.

Take off the outside strip that runs around the coil by loosening both the screws



How the knobs are attached to the coil

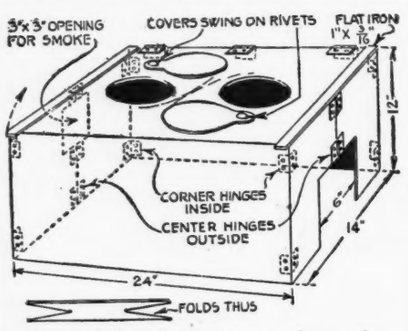
that hold it in place. Then use the strip as a guide or template for cutting another strip from thick, oiled cardboard, such as often is used for cheap notebook covers. Put this underneath the original strip and fasten a knob to both by means of glue and a small, flat-headed screw.

One of the hard rubber knobs on a discarded circular wall switch makes a good knob, as it is already tapped for a small screw. If you have access to a lathe, make the knobs of hard rubber or wood, which looks nearly as well as rubber if given a coat of black lacquer. Put these knobs on your set of honeycombs and you'll never take them off.—J. M. ROLSTON.

Sheet-Iron Stove for Automobile Campers Folds Compactly

COMPARED with the cobblestone method of spilling the beans, camp cooking with this stove is far more convenient. I have found it very satisfactory and it has the additional advantage of folding up so as to fit under the rear seat of the car.

The construction is shown clearly in the drawing. A light gage iron is used and the



A stove like this insures a good campfire

corners are reenforced where indicated with 1 by 3/16 in. flat-iron straps. All the hinges should be well riveted; the covers are loosely riveted, so that they may be turned to open or close the holes in the top of the stove.—ARTHUR F COX.

Drilling Oversize Holes

ANY twist drill will bore an oversized hole if it is ground slightly off center. The amount of "oversize" depends, of course, on how much off center the tool is ground.—H. B.

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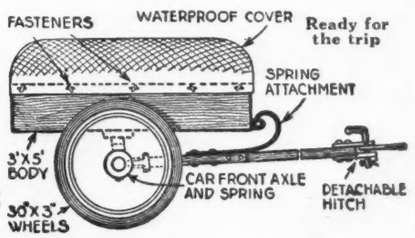
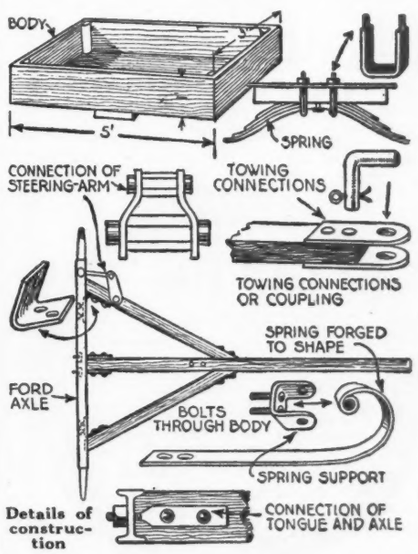


running. The attachment to the car consists of an oak or hickory tongue securely fastened to the axle with bolted wrought-iron straps and a pivoted detachable joint at the rear edge of the body of the towing-car. Two diagonal struts from the tongue to the outer ends of the axle to maintain the axle at right angles to the tongue are required. The bolted connections with the arms of the wheel spindles should be made substantial and the wheels brought parallel to the tongue.

A rectangular body 3 ft. wide, 5 ft. long, with an oak beam through the center, is secured to the spring by means of the U-shaped spring fasteners. At the front end of the body a special linked spring support is attached to overcome any tipping of the body on the running gear. This spring is



simply a leaf from one of the front springs forged to shape. It is advisable to lighten the front spring by the removal of several leaves unless the trailer is to be heavily loaded.

The cover for the trailer is a piece of waterproof or oiled canvas secured by means of eyelets on turn fasteners. While this trailer is suggested for camping and touring purposes, much hauling can be done with it, and due to the detachable connection it is quickly hitched and always in readiness for occasional hauling jobs about the home or farm.—A. L. S.

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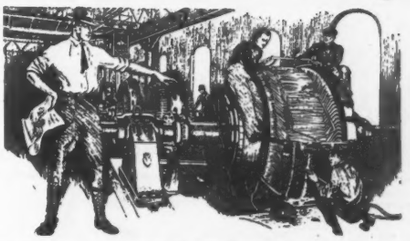

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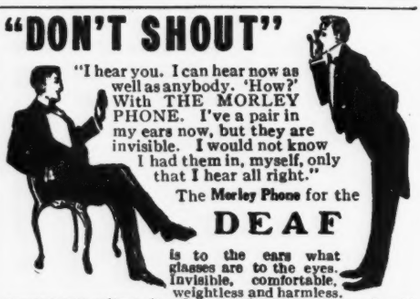
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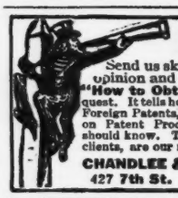
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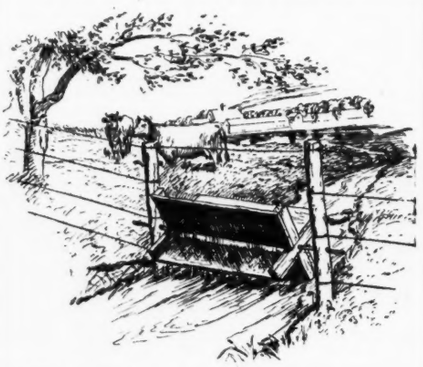
THE HOME WORKSHOP

Revolving Gate for Carrying a Fence across a Stream

WHERE a fence crosses a stream it is often a problem to arrange a contrivance that will keep cattle from straying and yet that will not cause floating trash to


This gate does not collect floating trash

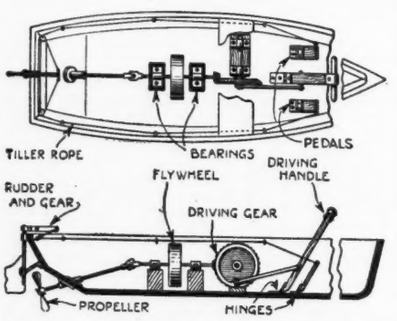
collect. This difficulty can be solved through the use of a revolving gate.

The wheel is made of two frames of 2 by 4 in. stock and four board blades, which may be of any width suitable for the size of the wheel it is desired to build. A length of gas-pipe serves as the axle and, as shown above, is supported on each side of the stream by a post.—ROBERT H. NEILL.

Old Auto Parts Will Provide Power for Rowboat

A ROWBOAT can easily be fitted up with old automobile parts so that it will have a propeller drive operated by hand power—something like a railway handcar.

From an auto-wrecking yard obtain a bevel gear as large as possible, and a pinion to mesh with it. Attach a heavy disk of sheet iron, about 14 gage, to the gear with bolts. Mount the bearings as shown and provide a shaft with an old gas-engine flywheel keyed to it. Connect it with the propeller shaft by means of a universal joint,



Top and side views of propelling mechanism

which may be made from two clevises. See that the mountings are rigid, so that there will be as little play as possible, and provide the stern bearing with a gland and stuffing to prevent leakage.

The hand lever is a heavy stick of wood, 2 ft. or more in length, hinged to the bottom of the boat. Make a connecting rod of iron, so that moving the handle back and forth will drive the gear, pinion, flywheel, and propeller. The steering-gear is operated by two pedals hinged to the bottom of the boat.—SHERMAN TERRY.

THE HOME WORKSHOP

You Can Cast Farther if You Use Tapered Leaders

TAPERED leaders for trout fishing are such an improvement over the ordinary level calibered leaders that, once they are used, they will always occupy first place in the angler's outfit.

The gut may be bought at any well-supplied sporting goods establishment in a quantity known as a "hank," usually composed of 100 strands of gut, each from 10 to

How the leaders are tied together

15 in. long. When tied together into lengths of from 6 to 9 ft., these form the leaders.

In making a tapered leader, one third should be of the heaviest strands found in the hank, the middle portion of a medium thickness, and the remaining length the finest of all. Select hard, round, and smooth strands; avoid those with inequalities. Before tying them into the leader, they should be soaked in warm, but not hot, water.

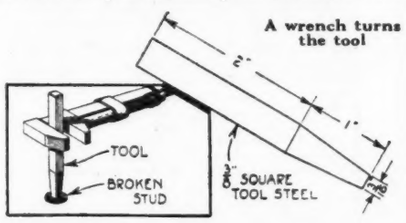
The knot used will readily be understood from the illustration. The ends *AA* are the long ends; the ends *BB* are the short ends. Pull the knots tight and then pull the two together, severing the loose ends with a sharp knife.

The hook can be connected more readily to a leader of this type, and the length of the cast is greatly increased. This is caused by the heavier part of the leader forcing forward at the cast, thus finally impelling the thinner forward portion ahead, much as when a long whip is cracked. An additional 10 or 15 ft. can be added to a cast with a tapered leader if a tapered line is also used.—ROBERT PAGE LINCOLN.

Removing Rusted Screws

WE are often confronted with the problem of removing broken screws, studs, or bolts, the heads of which have been twisted off or, as sometimes happens, sawed off. This is often a difficult task, especially when the threads are rusted from years of service. The screw may also be in a difficult position to get at.

I have in mind an experience which proved the practicability of the little tool



shown in the illustration. A ¾-in. stud had been twisted off the steam chest of a large engine and was rusted in place. After the engineer had tried in vain to back it out with a punch, I was called in. All I did was to drill a ¼-in. hole in the center of the stud about ¾ in. deep, drive in the tool and back out the screw with a heavy wrench.

The tool is made from a hardened tool steel bit. It is advisable to make one 5/16 in. square and another ⅜ in. square. If the tool works loose, it can easily be driven in tighter after each pull on the wrench.—C. W. CASTLE.

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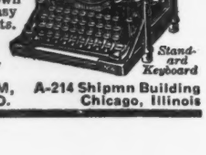

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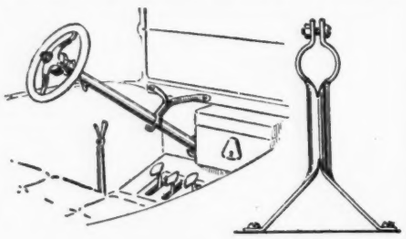
THE HOME WORKSHOP

Bracing Steering-Post against Vibration and Breakage

WHERE the steering-post on a Ford or other similar car is equipped with a long unsupported column, vibration is excessive and tiresome. The vibration is also detrimental to the steering post, causing it sometimes to break off at the base.

To overcome this, a simple form of brace can be added to clamp the post rigidly against the upper edge of the cowl, thereby



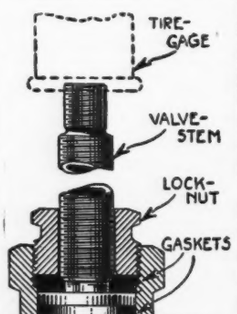
Split tubing supports the post

steadying it and hence providing more comfort for the driver and preventing the premature breaking at the bottom. A piece of steel or brass tubing about ¾ in. outside diameter is split as indicated and bent to form a footing for the brace, with a clamp to surround the post and fasten with a bolt.

The ends that support the post against the dash are about 10 in. apart. In making this brace, cut the clamp end for the steering-post and secure this first, leaving an excess of length to secure to the dash. These are then bent to fit and the excess is cut off. Avoid having the brace bend the post when attached in position.—A. E. G.

How to Make a Compression Tester Quickly and Cheaply

I HAVE found a simple substitute for the compression tester, which operates by putting it in place of the spark-plug, placing a pressure gage on it, and having some one turn the engine over against compression.



Sectional view

It was made from the shell of a spark-plug and the stem of an old inner tube. I placed a rubber gasket in the shell, filed the stem so that it would go into the shell also, put a small washer over the stem, and locked it in place with a locknut on the spark-plug shell. I then removed the valve-core and it was ready to use. It works perfectly and, in addition to that, costs nothing.—D. E. DARLING.

BY placing a worn-out three-cornered file flat on a piece of iron and striking it with a hammer so as to break off a small portion, I generally find a sharp corner left on one of the pieces that will cut glass as well as most commercial cutters. It adds another use to the worn-out file.—T. MCLAREN.

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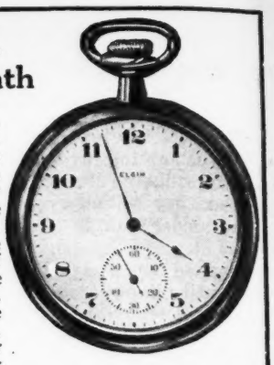

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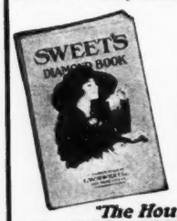

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1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Kenneth W. Payne, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Kenneth W. Payne, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y. 2. That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; Waldemar Kaempffert, 680 Fifth Avenue, New York, N. Y.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: O. J. Ridenour, New York, N. Y.; Samuel Insul, Chicago, Ill. 4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. CAPEN, *Business Manager.*

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How Others Did It!

HERE are the prize-winning pictures in the June contest, as they appear on other pages in this issue. Study them and you will find out the kind of photos that carry the winning punch:

FIRST PRIZE, $25—**W. K. Crosson,** Detroit, Mich. Subject—"Steam Hammer Pulls Pile from Frozen Ground" (see page 33).

SECOND PRIZE, $15—**Miss Grace T. Hadley,** New York City. Subject—"Fold Your Apartment Kitchenette into a Table" (see page 72).

THIRD PRIZE, $10—**Mrs. Thomas Baskerville,** Rahway, N. J. Subject—"Radio Set Completes the Trailer Camp" (see page 70).

Will you be a prize-winner for July?

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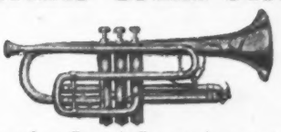

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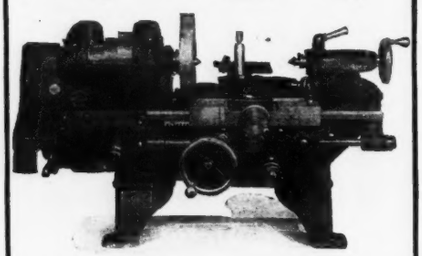

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Gipsy Motorists Tell How They Did It

Here are a few auto camping tips from letters submitted by readers of POPULAR SCIENCE MONTHLY'S "Gipsy Motorist" contest. Prize-winning letters appear on page 70 of this issue.

Cupboard Door as a Table

A RUNNINGBOARD cupboard, I found, is a necessity for the gipsy tour. Make it by bolting a board to the front and back fenders, just high enough to allow the doors to open. To the top of this hinge a board for a lid so that when it is opened it will serve as a table. In front of the front door of the car build a cupboard as high as the fender. This will be large enough for two shelves. The door is hinged to the same board as the other cupboard door, and when let down will make a good sized table. These tables are held in place by light chains that are tacked inside the cupboard.—JESSIE WARD, La Crosse, Wis.

A Trailer from Old Wheels

THE trailer that we used on our camping trip to Miami, Florida, was built from the axle and wheels of an old broken-down automobile and a box slightly longer than an average bedspring. On the trailer we carried blankets for ourselves and the children, who slept on a bed made above the seats in the "day coach."

Our tent was a sheet of heavy muslin, dipped in oil and dried, which was large enough to cover both cars and a seven-foot space between. It was held up by a ridge pole bolted to two supporting sticks. At Miami I earned some cash and all the fruit we wanted by picking grapefruit outside the city, where we were permitted to camp free of charge.—MRS. ANNA BRONNE.

An Auto "Berth de Luxe"

LAST August, three students and a dog found freedom and history along the Tuxedo Trail, the Shenandoah Valley Pike, and its connecting roads.

Our car, a sedan, carried six blankets, three sofa cushions, two sheets, four camp chairs, food box, five-gallon water jug, tent, three kit bags, and cameras. The bed, accommodating two, was made inside the car as follows: Removing both seat cushions from the car, we set up two camp chairs in place of the rear one. On these chairs, we adjusted the rear cushion. In the aisle, back of the front seat, the other two camp chairs were placed and the food box rested upon these. On these, we lay the front seat cushion, thus forming a compact, soft mattress even with the windows of the car. By opening the front windows, and stretching a pole between, we completed the length of the bed, and had a *berth de luxe*.—R. T. DIXON, New York City.

How to Win Hospitality

IN a roadster, my husband and I took our first camping trip last summer. With the help of the maps of the American Automobile Association we planned our route from our home in Chevy Chase, Md., to Green Cove on the Maine Coast, following the shore closely in New England. Returning, we passed through the White

(Concluded on page 109)

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Gipsy Motorists Tell How They Did It

(Concluded from page 108)

Mountains; down the "washboard road" of the Connecticut River valley to Springfield; over the Mohawk Trail to North Adams; through the Berkshires by way of Pittsfield to New York; then to Philadelphia, Baltimore, and home.

Near sundown we usually drove a mile or two from the main highway and asked permission to camp near a prosperous farmhouse. We were never refused. That hospitality is universal with our rural population is not the least that we learned on our trip. Appreciation, however, must be shown to have this hospitality continue. We showed ours by never building a fire without permission; leaving our campsite clean; sending back some word from our next camp and keeping our hosts posted as to our movements, as they were invariably interested in our future. Wherever we camped we left friends and received a hearty invitation to return.

The pleasure of camping for the future generations of gipsy motorists depends on the consideration shown by the present-day camper.—SUSAN S. ALBURTIS, Chevy Chase, Md.

Ideas for the Long Trip

THREE of our own inventions that greatly reduced the cost, bulk and weight of our equipment for a 5800-mile trip from New Hampshire to San Francisco last fall, were as follows:

Auto Bed. Materials: four S irons; two boards (1 by 3 by 40 inches) through which holes were bored; 50 feet of window cord. Two S irons hung over each side of the car support the two boards through which the rope is strung taut. When two auto cushions are placed upon the taut rope they fill the space between tops of the two seats. One end of a canvas (5 by 8) folded under the rear cushion, is then drawn tightly over all and fastened to the upper nuts on the windshield. Boards and rope, when released from irons, collapse into a small space. A comfortable bed for two people. Cost, five dollars.

Cooking Outfit. Wicker suitcase containing frypan, two kettles, coffee-pot, four aluminum plates; three food containers, washbasin. Elastic tape, sewed on inside of cover, provided pockets for tableware, Cost, three dollars.

Sleeping-Bags. Each sleeping-bag was made from a bed quilt, folded lengthwise, sewed across one end and three fourths up one side. Cost, nothing.—W. L. VOSBURGH, Oakland, Calif.

A Homemade Camp Outfit

OUR auto camping trip was so successful last year that my wife, who had never camped before, is enthusiastically helping plan another one this year.

We made a poleless auto tent by ripping an old peak tent and using the best part of it to make a 7 by 10 ft. shelter with flap to cover the car. We used a waterproof preparation liberally on the roof and not a drop of water came through this 30-year-old canvas, although we had three "drenchers" on our tour.

Our stove consisted of a two-hole top of a laundry stove, held up by a galvanized iron back bound with heavy wire, with two side walls hinged to it in order to pack flat. —GEORGE E. PAYSON, Alexandria, Ind.

Supervision by a Wageless Worker

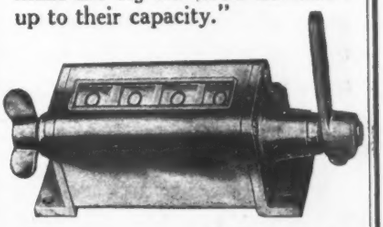
Supervision makes a machine (and its operator) *produce*, but supervision costs money unless done automatically by a Veeder Counter.

A counter that costs a few dollars will watch operations at your machine for many years.

You'll get a record of each piece produced; you'll get what you *ought* to get from the operator with a

Veeder COUNTER

Hundreds of inventors and machine users know Veeder Counters as "the little machines that make the *big* machines measure up to their capacity."



The above Revolution Set-Back Counter records the output of any machine where a shaft-revolution indicates an operation. Sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels, as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list). Smaller counters at prices from $2.00 up.

The Hand Tally illustrated below is used for counting anything from number of people attending a ball game, to number of packages in an inventory. In the public place it counts *persons;* in the factory or store it counts *stock;* in the "open" it may count anything from cattle on a ranch, to poles on a telephone line! Registers one for each pressure of the thumb lever; counts up to 10,000, then repeats. Can be set back to zero from any figure by turning knob once round. Size, exclusive of finger ring, 2 inches greatest diameter. Price, $5.00.

Write us about that counting problem of yours—it's already answered in the Veeder Booklet; copy free.

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That's why we make Neverslip Pliers with crucible steel cutting edges. Crucible gives a sharp, keen edge that lasts twice as long as ordinary pliers. But when the edges finally become worn you may quickly and easily replace them with a brand new set of blades at a trifling cost.

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NEVERSLIP
side cutting pliers

Neverslip Pliers are furnished in six, seven and eight inch sizes

If you use pliers or buy them for somebody else to use, you'll be interested in our booklet, "Procrastination is Not the Only Thief of Time". It's mailed free upon request. Do you want a copy?

Answers to Sam Loyd Brain Testers

Following are the correct solutions to Sam Loyd's puzzles that appeared in April and May issues. A brand new set of puzzles to answer, and the names of prize-winners in the February and March contests, appear on page 66.

Answers to April Puzzles

HOW DID THE RACE END?

The winning car won by a distance of 4 4/5 miles. Meeting seven times in a six-mile race around a mile track, as shown at the four-furlong mark, proves that the winner must have gone five times as fast as the loser. Therefore, as the winner completed six miles, the loser had gone but one and a fifth miles, losing the race by exactly 4 4/5 miles.

THE STEEPLE CLIMBER

When the climber had climbed in five spurts of six minutes each and fallen back in five jiffies, he had consumed 30 minutes and five jiffies, and had risen 15 feet. The remaining four feet and eight inches he covered in 4 2/3 minutes. On the last spurt there was no backward slip. The total time consumed, therefore, in reaching the top of the steeple was 34 minutes, 40 seconds, and 5 jiffies.

HOW MANY WEIGHTS?

Four weights—1/5 oz., 3/5 oz., 1 4/5 ozs., and 5 2/5 ozs. The numbers 1, 3, 9, and 27 are a progressive series with 3 as multiplier. The smallest weight weighed one quantity. Adding the 3/5 oz. made it possible to weigh the three next higher quantities. Adding the 1 4/5 oz. weight made it possible to weigh the nine next higher quantities. The final addition of the 5 2/5 oz. weight made it possible to weigh the 27 next higher lots.

Answers to May Puzzles

THE FALSE ALARM

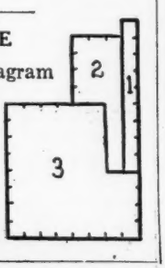
The alarm went off at either 2 14/143 minutes past 5, or at 25 25/143 minutes past 12 o'clock, two of those 143 different times when the hands might be reversed and yet be in natural positions on a correctly adjusted and true running timepiece.

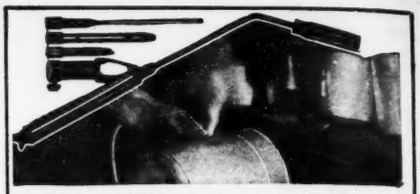
SAWING LOGS

The eight-foot logs required five cuts to produce 16-inch lengths, whereas two of the four-foot logs would require but four cuts. "Three times longer" is equivalent to "four times as long," so the five cuts of an eight-foot hardwood log would take just five times as long as the cutting up of two four-foot logs of soft wood. At the established rate an hour for his labor, the man would be paid an even $12 for cutting up the second cord of wood.

THE METAL SQUARE

The accompanying diagram shows how the metal worker produced his odd-shaped piece from three pieces of a square. Pieces 1 and 2, dropped down, will just fit in with 3 to form the original square.





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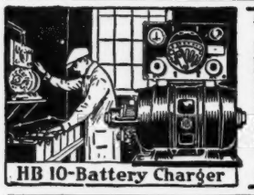
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The Shipshape Home

How to Do the Odd Jobs

Window Shades

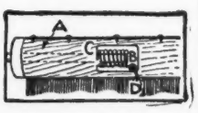
If a window-shade will not run up as far as desired and the spring seems weak, pull the shade down as far as possible. Lift out the roller and roll up the shade by hand. Replace it carefully in the little brackets. The tension will then probably be tight enough. More tension can be given to the spring, if necessary, by repeating the operation.

If there is too much tension or "spring," reverse the process. Let the shade go right up as far as it will go, lift it from the brackets, and unwind half the length of the shade by hand.—R. D.

Spring Rollers

When the spring of a window-shade breaks, the shade is usually thrown away as worthless. I have found a simple method of repairing them that will save the handy man many a dollar.

Usually the break occurs at the point *B*, where one end of the spring is connected with the wooden roller. With a knife or light tool tap along the roller *A* to find where the hollow part enclosing the inside spring ends. When this point has been found, cut a hole with the knife, as at *C*.



Remove the nail that holds the broken end, and with the pliers straighten and bend an eye in the end of the spring. Then nail it back in place as at *D*. The roller will then be as good as new. If the spring should break again, it is an easy matter to repeat the operation.—J. De Santis.

Hints on Stenciling

To handle a long, narrow stencil on a ceiling, tack it on a yardstick or fasten it on with shellac. Give the outside edge of the stencil and the yardstick a coat of shellac and press them together with weights for about 10 minutes.

If you wish to cut a stencil and have no regular paper on hand, use a heavy grade of common paper. The backs of catalogs make very good small stencils, although short lived. Use two coats of shellac, cut your design, and give the stencil at least two more coats of shellac after it is cut.

A safety-razor blade makes a good tool with which to cut a stencil. In cutting stencils, lay them on either zinc or glass to insure clean lines. After you are through, clean your stencil thoroughly and give it a thin coat of shellac. It should be hung out of the way.—C. O. Soots.

Tightening Cane Seats

To clean and restore the elasticity of the cane seats of chairs, turn the chair bottom upward, and with hot water—and soap if needed—wash well, so that the cane is thoroughly soaked, without, however, getting any water on the woodwork. Let the cane dry in the air, and it will be as tight and firm as new, provided, of course, it is not broken.—S. M.

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Be sure of your *methods*.

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Making Money with Tools

ARE you making money with your home workshop?

If you are not, thousands of other home workers are, and you will be interested in knowing how they do it. To learn their methods, watch this department for the next few months, because, starting in July, it will have one of the most remarkable series of articles on this subject ever published.

These were submitted by readers of POPULAR SCIENCE MONTHLY in the contest, "How I Made Money with My Tools." Each one tells exactly, concretely, and most entertainingly how some man is earning extra money with his tools.

The awards have been made as follows:

First Prize, $50, Peter Petkoff, Minneapolis, Minn.

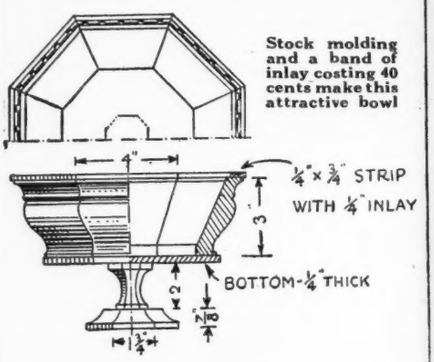
Second Prize, $25, D. J. Spencer, Price, Utah.

Third Prize, $15, Edward Jones, Frankfort, Mich.

Making Inlaid Fruit Bowl from Piece of Crown Molding

THREE feet of crown molding and a little inlay, the cost of which should not exceed 40 cents, will make a fruit bowl fit to grace any sideboard.

Plane and scrape smooth the back and edges of the strip of molding, sandpapering until it is as smooth as it can be made. An octagonal bevel is then planed on the bottom, the marking being done with the bevel held against the square side. The same bevel is also cut on the top, the bevel being held against the curved side.



Stock molding and a band of inlay costing 40 cents make this attractive bowl

The sides for the bowl should be cut very carefully in a miter box, which can easily be made from three strips of wood. The pieces should be glued together and held with a large rubber band around the top of the bowl. Turn the bowl upside down while drying.

The stem and base are constructed as shown. The top border is of thin wood grooved for a strip of commercial banded inlay. If a combination plane is not available, the groove may be marked out with a very sharp marking gage and then chiseled. The bordering strip is glued to the top of the bowl and also nailed with small brads driven in through the groove where the inlay is to be placed.

Finish the bowl with mahogany or walnut stain, shellacked and varnished, or waxed. A piece of felt should be glued to the base.—GLADSTONE CALIFF.

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